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TITLE OF THESIS/*TITRE DE LA THÈSE* Systematic Desensitization of Mathematics Anxiety

UNIVERSITY/*UNIVERSITÉ* University of Alberta

DEGREE FOR WHICH THESIS WAS PRESENTED/*GRADE POUR LEQUEL CETTE THÈSE FUT PRÉSENTÉE* Master of Education in Counselling Psychology

YEAR THIS DEGREE CONFERRED/*ANNÉE D'OBTENTION DE CE GRADE* 1977

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THE UNIVERSITY OF ALBERTA

SYSTEMATIC DESENSITIZATION OF MATHEMATICS ANXIETY

by

© D. Elaine Gillingham

A thesis

Submitted to the Faculty of Graduate Studies and Research

in partial fulfillment of the requirements for the degree

of Master of Education

in

Counselling Psychology

Department of Educational Psychology

Edmonton, Alberta

Fall, 1977

THE UNIVERSITY OF ALBERTA

FACULTY OF GRADUATE STUDIES AND RESEARCH

The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research, for acceptance, a thesis entitled "Systematic Desensitization of Mathematics Anxiety" submitted by D. Elaine Gillingham in partial fulfillment of the requirements for the degree of Master of Education in Counselling Psychology.

Geo. J. Gutsmans
(Supervisor)

A. T. Olson

E. E. Fox

Date 1 August 1977

DEDICATION

To my family, for their continuing love

and support

ABSTRACT

This study investigates the therapeutic value of systematic desensitization with mathematics anxiety and the possible resultant effect on attitudes towards mathematics. The subjects were undergraduates in an elementary education mathematics methods course. Four groups were formed as defined by their responses on the Mathematics Anxiety Rating Scale, Suinn 1972(MARS); High Anxious Treatment Group I (receiving treatment first), High Anxious Treatment Group II (receiving treatment second), High Anxious No-Treatment Group, and Mid/Low Anxious Groups (no treatment).

Pre-treatment, post-treatment, and follow-up assessments of anxiety (MARS) and attitudes (Aiken Attitude Scales - Enjoyment and Value) demonstrated that systematic desensitization was a successful treatment procedure for Mathematics anxiety, with those receiving treatment earlier displaying the greater reduction in anxiety level. No statistically significant attitude change resulted, however indications of improved valuing of mathematics occurred within the treatment groups.

The results of the statistical analyses were supported by subjective self-reports.

Providing a treatment program for mathematics

anxiety with future groups of teachers-in-training, using systematic desensitization or a similar therapeutic technique, is called for. Essential elements to consider would be to provide such treatment quickly and early in the academic year.

ACKNOWLEDGEMENTS

I would like to express my appreciation to my thesis chairman and supervisor, Dr. G. W. Fitzsimmons for his expert guidance, patience, and continued encouragement throughout this year of study. I would also like to express my gratitude to the other members of my committee; to Dr. A. T. Olson, whose assistance and support were particularly helpful throughout this project, and to Dr. E. E. Fox who during this year of graduate studies has continued to be an inspiration.

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CHAPTER I

INTRODUCTION

> "One thing I found most helpful was that there were so many fellow-sufferers. I didn't seem to be the only one..."
>
> "This program would be a helpful addition to the undergraduate education program..."
> "as long as students are not too 'frightened' to admit their fears!!"
>
> Responses taken from a self-report questionnaire, as expressed by a participant in this study

Society at large has begun to acknowledge the growing presence of an insidious parasite, anxiety, which feeds on the energies of individuals, with an often devastating result. It is to this issue that much recent research has addressed itself, to anxiety and its remediation. The focus of this study was mathematics anxiety as displayed by elementary teachers-in-training, and its remediation. The therapeutic program which was applied was Systematic Desensitization, a behavior therapy developed by Joseph Wolpe in 1958 to alleviate debilitating anxieties (Wolpe, 1973).

The Problem

The present study was designed to investigate the viability of applying systematic desensitization therapy to alleviate mathematics anxiety as exhibited by elementary teachers-in-training. A high level of anxiety towards mathematics could present a professional hazard to the teacher who in turn represents a potential influence on the development of attitudes towards and achievement in mathematics for the elementary school child.

The population to which the study was directed, an elementary education mathematics methods class, was defined and placed into groups designated high or mid/low anxious, based on the scores achieved on the Mathematics Anxiety Rating Scale as revised by Richard M. Suinn (MARS, 1972).

From the literature it was anticipated that those high anxious receiving treatment would report a reduction in the level of mathematics anxiety to a degree beyond that of those high anxious who did not receive treatment.

A second focus was in terms of the time of treatment, presented initially or in mid-term. To address this issue two treatment groups were formed from those of the high anxious group who volunteered to participate in the program, one to receive treatment at the outset of the term, the other to receive treatment in mid-term. It was

anticipated, as the literature suggests, that regardless of the time of treatment the effectiveness of the program would be the same, namely that both treatment groups would experience similar reductions in anxiety level and achieve similar levels of anxiety following treatment as measured by the MARS.

Thirdly, it was of interest to evaluate the lasting effects of the systematic desensitization treatment over a period of time. It was anticipated that the reduction in mathematics anxiety achieved following treatment, for the group receiving treatment first, would be retained over a 4 week follow-up period as indicated by several studies reported in the literature.

Fourth, the study focussed on the possible relationship between anxiety and attitudes towards mathematics. Would the alleviation of the anxiety, through systematic desensitization, effect a change in the attitude towards mathematics? The literature suggests that the relationship between anxiety and attitude towards mathematics is a complex one. Indications are that attitudes towards mathematics were not perceptively altered by the successful treatment of mathematics anxiety, following systematic desensitization treatment. It was anticipated therefore, that in the present study, though systematic desensitization would successfully reduce the

level of mathematics anxiety the attitudes of those treated would not be appreciably effected.

Lastly, performance measures were evaluated across all groups in the population, both high anxious groups receiving treatment, the high anxious group who did not receive treatment, and the mid/low anxious group to whom the treatment program was not offered. Several studies reviewed reported that performance was not effected by the successful remediation of anxiety. It was anticipated that by the end of term performance measures would not be noticeably different across all groups.

Rationale for this Investigation

Since its introduction in 1958, systematic desensitization, in numerous research studies, has been demonstrated to be an effective therapeutic technique for the reduction of anxiety with a variety of phobias; kleptomania (Mazagas, 1972), oral exams (Bruno and McCullough, 1973), mathematics anxiety with university students (Richardson and Suinn, 1973) and test taking (Deffenbacker and Kemper, 1974) to name a few of the more recent applications of the procedure.

To date however, there appears to have been no studies reported that investigate the application of systematic desensitization therapy to mathematics anxiety with

teachers-in-training. It was to this issue that the present study was addressed, mathematics anxiety in elementary teachers-in-training, which represented the first reported application of desensitization therapy to a Canadian university population in the area of mathematics anxiety.

Over the years modifications in Wolpe's original procedural format have proven to be equally effective in terms of anxiety reduction. Many of these modifications have broadened the prospective client base and accelerated the rate at which the program can be successfully applied. Both have improved the therapist's effectiveness by affording him or her the possibility of effectively treating more clients and with greater efficiency.

Some of the modifications have been as follows:

1) Grouped Desensitization. It has been demonstrated that a large group can work effectively together. A few of the more recent studies dealt with anxiety-based disorders (Dawley and Wenrich, 1973) with test anxious student nurses, (Bardbasz, 1973) and test anxious elementary school children, (Deffenbacker, 1974) with te t anxiety.

2) Common hierarchy. When working in a group setting use of a common hierarchy allows for continuity of presentation and progress across all subjects involved. (Deffenbacker 1975, and Zenmore, 1975).

3) Automated Presentation through Audio-tape. To facilitate the continuity of presentation and/or allow for self-regulation of the presentation, the relaxation techniques and hierarchy presentation have been prepared on audio-tape as successfully demonstrated by McGlynn, Dudley and O'Brien (1972) with a dissection phobia for a Zoology student, and by Suinn, Edie, Nicoletti, and Spinelli (1973) with test anxiety.

Successful adaptations of systematic desensitization have incorporated its extension to group treatment, the substitution of individual with standardized hierarchies, and the use of audio-tape. It was with these adaptations that the systematic desensitization therapy was applied in the present study.

Though the relationship between attitudes and anxiety towards Mathematics has been investigated in numerous studies (Aiken, 1976) the issues remain somewhat unclear. No research reported to date has looked at this relationship as it occurs within elementary teachers-in-training. The literature suggests that the development of attitudes and anxiety towards mathematics appears to occur during the late elementary, early Junior High school years. Considering the potential effect this group may have on the elementary school child, the present study addressed itself to this relationship between anxiety and

attitudes towards mathematics within elementary school teachers-in-training.

Limitations of this Study

The findings of the present study regarding the effectiveness of the treatment program in the reduction of mathematics anxiety in elementary teachers-in-training should be viewed with the following limitations in mind.

Of the initial 141 subjects in the total population only 22 were male. Though indications in the literature suggest sex variations do exist in terms of both mathematics anxiety (Greer, 1973) and attitudes towards mathematics (Aiken, 1976), the disproportionate nature of the sex distribution within the population made this issue one to which the present study was unable to address itself.

The results should be considered with some caution in terms of generalizability due to the small sample size involved in the treatment program (N=11, N=7).

Group placement was determined by an initial assessment of the anxiety instrument (MARS). The responses reported by some of the subjects may be more a reflection of a momentary feeling of anxiety rather than representative of a general feeling of anxiety regarding the various situations presented. However, this effect may be minimal

as validity data suggest the instrument does measure mathematics anxiety effectively which would take the aforementioned situation into account.

Though test-retest reliability is moderately high for the MARS, r=.85 over a 7 week period, the instrument, as well as both Attitude scales, were used on 4 occasions over a 9 week period with those receiving treatment. Familiarity with the instruments was a factor that should be considered.

Though performance measures used indicated a trend of no significant differences occurring across the groups, the results may have been effected by the loss of twenty-six subjects due to the unavailability of one of the five seminar groups which had not been evaluated by the same measures as the other four groups.

Lastly, as with most research studies, treatment participation was on a volunteer basis. From those defined as high anxious came the volunteer/non-volunteer groups. The motivation to volunteer appears to be a variable that merits some consideration since results achieved by the treatment group were on some occasions evaluated in comparison to those achieved by the non-volunteer group.

Keeping the aforementioned possible limitations in mind, the present study does appear to offer supportive

evidence of the efficacy of successfully applying systematic desensitization therapy for the treatment of mathematics anxiety with elementary teachers-in-training.

CHAPTER II

THEORETICAL FOUNDATIONS

Chapter II outlines the theoretical foundations upon which the present study was based. The first section focusses on the conceptual framework from which the systematic desensitization treatment procedures evolved. Following is a description of systematic desensitization in terms of the aforementioned theoretical base. The third section addresses itself to the relationship between anxiety, attitude and achievement in terms of mathematics with reference to the recent body of literature in this area. The fourth section outlines the procedure of systematic desensitization as suggested by Wolpe. The chapter concludes with a review of recent research on systematic desensitization treatment of anxiety.

Conceptual Framework

From a behavioral perspective personality consists primarily of behaviors, habits which are learned. Each individual's personality reflects the unique events to which each has been exposed. Habits are thus defined as consistent ways of responding to specific stimulus con-

ditions in the environment. Linkages are made between the stimulus cue and the response. Through repeated associations habits are thus learned. When habits become nonadaptive, fail to fulfill the needs, drives of the individual, they usually extinguish. However, some nonadaptive habits fail to do so. It is to these that behavior therapy addresses itself, to which experimentally established principles of learning are applied, and to which the present study was directed.

Experimental studies of normal and abnormal behavior revealed factors that determine the acquisition, elicitation, maintenance, and decline of habits; developing a conceptual position for which Pavlov, classical conditioning, and Skinner, operant conditioning, were the major contributors initially. Out of their work and that of others grew an hypothesis regarding abnormal behavior, nonadaptive habits, that if behavior is learned it can be unlearned.

Several researchers such as Watson and Rayna, Jones, Herzberg and Terhune, Guthrie, as reported by Wolpe (1973), demonstrated that neurotic symptoms, from the behavioral point of view, are conditioned responses that have become nonadaptive. Neurotic behaviors and their symptoms are due to conditioning, learning. Therefore, treatment should focus on the symptoms, the nonadaptive

learned responses, rather than on the possible underlying causes as had been suggested by Freud and the psychoanalytic school.

Eysenck, as reported in Spielberger and Sarason (1975) postulates three basic characteristics of all neurotic behavior, that it is learned, is maladaptive (not serving our purposes) and involved is strong emotion, specifically anxiety. Needless to say, anxiety is an appropriate response to situations in which realistic danger exists. This would be rightfully named adaptive anxiety. However, when stimulus situations which present no real danger or threat evoke anxiety, then the anxiety thus aroused would be considered inappropriate, nonadaptive. It is this type of anxiety that is at the core of neurosis.

Often as a result of conditioning, a great number of stimulus cues to nonadaptive anxiety are established. Spielberger, in Spielberger and Sarason (1975), speaks of anxiety as a complex process, a sequence of cognitive, affective, and behavioral events evoked by some form of stress through internal or external cues. At the centre of the anxiety process is the anxiety state which Speilberger describes as "subjective, consciously perceived feelings of tension, apprehension and nervousness with activation of the autonomic nervous system" (Spielberger

and Sarason, 1975, p. 137).

"Since anxiety is generally a central constituent of neurotic habits the deconditioning of anxiety forms the core of their treatment" (Wolpe, 1973, p.21). From this basic conceptual orientation one of the more widely used therapeutic treatments of anxiety evolved, that of systematic desensitization, developed by Joseph Wolpe in 1958. The basic premise upon which systematic desensitization has developed is that "if a response inhibiting anxiety can be made to occur in the presence of anxiety evoking stimuli, it will weaken the bond between these stimuli and the anxiety" (Wolpe, 1973, p. 17).

Systematic Desensitization: Theoretical Foundations

Systematic desensitization attempts to break down the neurotic anxiety response habits that have been learned through a counter condition process. The basic principle underlying the procedure is that a particular response (anxiety) to a given stimulus may be inhibited by the presentation of a stronger response antagonistic to the anxiety.

The neurotic anxiety response habits tend to not be extinguished since the anxiety generally leads to an avoidance response which in itself reinforces the anxiety. In order to change the anxiety response it is imperative to gradually increase the approach response to a

strength sufficient to replace the avoidance response.

A physiological state inhibiting to anxiety is induced in the subject, usually deep muscle relaxation following a modification of Jacobson's progressive relaxation techniques developed in 1938. The autonomic effects of relaxation are diametrically opposed to those characteristic of anxiety as described earlier. The subject is then presented with a weak anxiety arousing stimulus. In this instance the relaxation response is stronger than that of the anxiety response. Over repeated exposures for brief periods of time, the association of the stimulus event with the anxiety response is gradually weakened and broken, while being built up in its stead is the new association of the same stimulus event with the relaxation response. Successively stronger stimuli are similarly introduced and treated. In a step by step fashion previous associations between stimuli cues and anxiety responses are broken down and replaced by the new associations - a process described by Wolpe as reciprocal inhibition, the relaxation reciprocally inhibiting the concurrent anxiety, weakening the anxiety response habit.

Anxiety, Attitude, Achievement and Mathematics

Over the years researchers have continued to address themselves to the questions of what constitues mathematics attitudes, the possibilities of affecting a

change in attitude, mathematics anxiety and its treatment, and the inter-relatedness of anxiety, attitude and achievement in mathematics. Recent research directions have made new and often enlightening inroads along all of these dimensions as reviewed by Aiken (1976).

There has been an increasing emphasis on instrumentation to more accurately assess mathematics attitudes across all school ages, elementary, secondary, and college levels. A multi-dimensional approach has evolved, viewing attitude as a conglomerate of several component parts each of which is to be assessed to more effectively understand what attitude is and perhaps bring light to bear on where attitudes are most likely to be affected.

McClure's scale (1971) for the secondary school level, assesses four major components, mathematics content, problem solving, teacher, and facilitative factors. Sandman's 48 item inventory (1974) for the secondary school level, assesses 6 constructs of attitude, perception of the teacher, anxiety, value, self-concept, enjoyment, and motivation. At the college level, Aiken (1974) has developed a 2 component instrument, assessing enjoyment and perceived value of mathematics, with which the subjects' attitudes were assessed in the present study.

A second emphasis in the recent literature has been on the relationship between attitude and achievement. Though level of ability is generally accepted to be the

best predictor of achievement, a low but significant correlation has been shown to exist between attitude and achievement. Research has demonstrated this correlation to exist across all school levels, elementary, secondary, college (both undergraduate and post-graduate), with American minority groups, and with students in other countries.

The relationship between attitude and achievement has been investigated in other contexts as well. Research suggests that the most influential years in terms of the development of attitude towards mathematics appear to be the late elementary and early Junior High School years. Though research findings have been somewhat contradictory, indications are that sex differences do exist in both attitude and achievement in mathematics with males frequently being superior in both at the Junior High level and beyond. Mathematics anxiety appeared to be more prevalent with girls at these same levels. It has been suggested by a few researchers that this difference may reflect the more socially-oriented female being somewhat less interested in concentrating on mathematics than the males. Thus the correlation between attitude and achievement appears to vary both with grade level and between the sexes.

Attitude, ability and anxiety all seem to be dynamically inter-related. Ability level is determined in large part by genetics, however lack of early success

regardless of the cause can easily lead to a negative attitude and possibly, as a result, to the development of a mathematics anxiety.

A third area of research that has justifiably come under closer scrutiny is the relationship between the students' attitudes towards mathematics and the teacher, bearing in mind the potential influence the teacher has on the students. One issue that has been of interest focussed on the possibility of developing a more positive attitude towards mathematics and thus alleviating the potential development of mathematics anxiety. A variety of innovations have been investigated in terms of varying the presentation of lessons to the students such as the following: enrichment classes, laboratory work, computer programing, individualized learning, and microteaching. However, none had been demonstrated to be significantly more effective in the development of improved attitudes as compared to a more traditional approach. The use of devices such as calculators have generally proven to be ineffectual in altering attitudes as well.

Another issue within the area of teacher influence is the possible effect the teacher's attitude has on that of the student. Results are confusing for variations occur from teacher to teacher and from student to student. Further investigation has been suggested as indications are

that a relationship between these two appears to be a distinct possibility.

A fourth major area of investigation has been that of mathematics anxiety, its treatment and the possibility of a subsequent effect on attitude and performance. Studies have demonstrated the successful reduction of mathematics anxiety, however no significant improvement in attitude or performance have been reported to date.

Aiken (1976) concludes his review of the recent research on mathematics attitudes with suggested directions that merit further investigation: the use of multivariate instrumentation in assessing mathematics attitudes, closer scrutiny regarding the relationships between the numerous variables involved such as teachers, students, courses and methodology to name but a few, and the extension of the treatment of mathematics anxiety incorporating a variety of behavioral techniques.

It was to these issues that the present study was addressed, in the treatment of mathematics anxiety with teachers-in-training, who pose a potential influence on the elementary students, with attitude having been assessed by a multidimensional instrument (Aiken Attitude Scales) and a behavioral therapy treatment having been applied to the anxiety expressed (systematic desensitization).

Systematic Desensitization Procedure

Wolpe suggests four operational procedures involved in systematic desensitization: the initial interview, deep muscle relaxation training, hierarchy construction, and desensitization. I will briefly outline each. I would refer the reader to Wolpe (1973) for a more explicit treatment description.

Initial Interview: The initial interview is an important first meeting with the client(s) in which rapport is established, a detailed history with specific reference to areas of anxiety-arousal is taken, and the general principles of the process of systematic desensitization are explained. Wolpe suggests use of the Willoughby Personality Schedule and the Fear Suvey Schedule to further explore the anxiety dimensions of the client. He suggests also giving the client homework involving a probing into all situations that elicit any anxiety. In this initial interview it is imperative to make clear to the client the basic underlying principle, that nonadaptive behaviors like anxiety are learned and therefore can be unlearned, to be replaced by other more appropriate responses.

Relaxation Training: The methodology is one that follows essentially Jacobson's model as explained in Progressive Relaxation written in 1938, but at a much more accelerated rate encompassing lessons followed by practice

sessions at home, which Wolpe suggests should be for fifteen minutes twice a day.

Initially, the therapist explains to the client the purpose of the relaxation training, outlining its role in anxiety reduction, with a brief explanation of what is going to follow in the deep muscle relaxation process. Whatever muscle sequence is used it should be orderly. Wolpe began with the arms for the convenience and ease in checking the degree of relaxation achieved in the client. From there he progresses in the following manner: head region; teeth, lips and tongue; neck and shoulders; back, abdomen, and thorax; lower limbs.

In each instance the procedure is one of asking the client to tense the specific muscle area for a few seconds, to experience the feeling of that tension, then to relax and notice the difference in sensations. Focus is on "letting-go" and extending this feeling. The client is assured that good relaxation comes with practice. Often deep breaths are a facilitating addition to "letting-go" as expiration is essentially a "letting-go". After a time, several clients have been known to coordinate deep muscle relaxation with exhalation during normal breathing.

Assessment of progress and ability to relax depends on client-report calmness and on observations of the therapist. Objective indications are helpful such as heart

beat, G.S.R., E.M.G., which in turn facilitate the program for the client as sources of feedback regarding his success in achieving deep muscle relaxation.

Construction of Hierarchy: An anxiety hierarchy is a list of stimuli on a theme, ranked according to the amount of anxiety they evoke, least anxiety-arousing stimuli to highest anxiety-arousing stimuli at the top. The theme is a direct ougrowth of the information gathered from the initial interview and forms the common core of the family of anxiety-evoking stimuli affecting the client. The source may be external (i.e. spiders, snakes) or internal (i.e. feeling of losing control). Regardless of the source the process is the same.

Often hierarchy construction begins the same time as relaxation training and can be altered or added to at any time when necessary. The gathering of the data and its organization are done in a conversational atmosphere where the normal responses are in evidence, of which the therapist must be aware. The data is gathered from the various sources mentioned during the initial interview. From those the themes are derived and the hierarchies are then organized for each theme in evidence.

In hierarchy construction there are several considerations. The situations used only have to be able to be imagined by the client, they do not have to have been

experienced. There are often variations in dimensions within the components of the hierarchy. Inadequacies often only become evident once desensitization has begun. For example, if anxiety doesn't diminish on scene visualization it would be necessary to stop that scene and find a new scene which elicits a less-disturbing level of anxiety, weak enough to be inhibited by the relaxation response. Items must be reasonably spread in terms of anxiety arousal for progressive steps to be made with no plateaus or no large jumps that would increase anxiety level too quickly. Basically, the anxiety aroused is a power function of a specific situation, for example with claustraphobia, anxiety would be a function of the size of an enclosed space.

Desensitization Procedure: Once deep muscle relaxation skill has been achieved and appropriate hierarchies have been developed desensitization is possible. The first session is exploratory to clarify the level of anxiety that the client is feeling. Wolpe uses the SUDS scale which he developed (Wolpe, 1973, p. 120) to indicate the level of anxiety being experienced. Initially time is taken to develop deep muscle relaxation in the client. The first scene presented is used as a control, neutal in that it should not elicit an anxiety response in the client. This provides information regarding the ability to

visualize and to record any extraneous anxiety that may be operating. If anxiety is evident it must be dealt with before proceding further.

The basic procedure is as follows: the client is told he will be asked to imagine a number of scenes that will be described to him, that he is to indicate (i.e. raised index finger) once each scene is clearly formed. Once relaxation is achieved the therapist proceeds with scene presentations starting with the lowest item in the hierarchy, asking the client to imagine it for 5 seconds which ends when the therapist directs the client to "stop that scene" and relax. Wolpe suggests asking the client for the number of SUDS of disturbance the scene has elicited. Following a 20-30 second period of relaxation the same scene is imagined again for 10 seconds, followed by the signal to stop and relax. Usually when the scene can be imagined over two consecutive presentations of approximately 20 seconds each with no visible anxiety (SUDS of 0) the client is ready to proceed to the next item on the hierarchy. This process continues on through all items of the hierarchy, each eliciting no anxiety in turn before proceeding on to the next item.

Needless-to-say, movement through the hierarchy is not always so smooth. If an item elicits a great amount of anxiety, stronger than the relaxation response, the cli-

ent is immediately instructed to stop and relax. The client is then returned to a lower item on the hierarchy, a new intermediary step may then be introduced to graduate the anxiety-arousal more smoothly between the last two items. Wolpe suggests each session end with an item which has been completely desensitized. However, if the last item used did not fully reach a zero SUDS level, start with it on the next session. At times a kind of "spontaneous recovery" effect is noted and an item previously having no anxiety arousal may elicit arousal. It must then be desensitized once again before moving on. It is important to keep a careful record of the desensitization process.

Wolpe suggests that the length of the desensitization process is a direct function of the number of scenes within the hierarchy, their severity, and the degree of generalization to other stimuli that has taken place in the anxiety.

Review of the Literature: Systematic Desensitization of Anxiety

Numerous studies have followed Wolpe's initial postulations of 1958, several of which question some of his procedures, offer alternative approaches, suggest variations on his theme, to which this section alludes.

Traditional Desensitization: It has been demonstrated fairly conclusively that systematic desensitization, as Wolpe described it, is a useful therapeutic procedure in anxiety reduction to which a great variety of studies attest: Mazagas (1972) with kleptomania, Bruno and McCullough (1973) with a fear of oral exams, Tyre, Maisto and Companik (1973) with stuttering, Deffenbacker and Kemper (1974) with text anxious 6th graders, Word and Rozynko (1974) with an avoidance response causing reading problems in an 11 year old girl, and Cavior and Deutsch (1975) with a dream-induced anxiety in a 16 year old male . . . to name but a few of the more recent works in this area.

Role of Relaxation: Relaxation as a component feature of the process has received a great deal of attention in recent studies. Indications are that relaxation training in itself is useful in self-management of tension (Sherman and Plume, 1973) which gave rise to possible implications in school settings with young children. Jacobson's (1974) and Keoppen's (1975) subsequent investigations in this regard suggest that relaxation exercises are potentially significant in helping children reduce muscle tensions and anxiety and can be presented individually or in groups, in physical education classes or in the regular classroom setting, for which Keoppen offers a procedural outline.

However, relaxation appears to be most effective

in anxiety reduction when paired with desensitization (Hyman and Gale, 1973). It was a combination of procedures that consistently proved to be the most effective in the following studies: short-term desensitization, traditional desensitization, and relaxation alone (Orr, Mitchell and Hall, 1975), self-relaxation and rehersal feedback (Sherman, Mulac, and McCann, 1975), and with attention training and relaxation (Little and Jackson, 1975).

Hyman and Gale further postulate, as a result of their investigation, that the relaxation technqiue involves attempts to control the physical experience of fear. Systematic desensitization is thus due possibly to attacking both the cognitive and physiological components of the fear response.

Few alternatives to relaxation were discussed, use of laughter in treating a heterosexual social anxiety (Ventis, 1973), but this does suggest an area for further research.

Procedural variations have proven to be interesting, use of cue-controlled relaxation to increase the speed and efficiency of the procedure (Russell and Sipich, 1973), and EMG feedback which Canter, Kendo and Knott (1976) demonstrated to be a useful addition to relaxation training noticeably improving the overall effect.

Variations on the Procedure: Several studies have made adaptations to the traditional systematic desensitization process with interesting results. It has been found that systematic desensitization can be equally effective when self-administered (Morris and Thomas, 1973; Dawley, 1974; Arkowitz, 1975), presented through vicarious means (Denney, 1974), and automated using standard hierarchies of which Deffenbacker (1975) has developed two, for test anxiety and public speaking. Greer (1973) suggests the use of automated desensitization to minimize the sex variable which he found to be operating between therapist and client with therapits of the opposite sex to the client, being more effective.

Automated Desensitization: Studies have investigated the efficacy of automated treatments in desensitization as was indicated earlier with consistently positive results in the reduction of anxiety across a variety of phobic areas. Innovations demonstrated to be effective were in the following areas: use of video-taped presentation of the hierarchy (Beck, 1972), short term desensitization (Suinn, Edie, Nicoletti, and Spinelli, 1973), and with massed treatments (Holland Henkle, 1972).

The role of the therapist was effectively evaluated against the automated techniques by Spinelli (1973) who found that only in terms of attrition rate and subjec-

tive satisfaction was the therapist an influence. In terms of anxiety reduction no significant differences occurred across all combinations of from one to several to no therapist.

These findings imply that systematic desensitization may be administered profitably to large groups, in massed sessions, and with video and audio-tape.

Treatment may be carried out in a more efficient manner than originally suggested by Wolpe for which the use of a standard hierarchy has proven to be quite effective.

Grouped Desensitization: Massed grouped desensitization has been demonstrated to be an effective procedure for a variety of anxiety areas which allows for a more efficient use of both counsellor and client(s) time: Dawley and Wenrich (1973 with test-anxious nurses, Barabasz (1973) with test anxious 5th and 6th graders, Deffenbacker (1974) with test anxiety, and Parker (1975) with public speaking anxiety.

Some other interesting developments have evolved from these investigations. Zenmore (1975) noticed a generalizing effect, following treatment of test or public speaking anxieties subjects reported a carry-over of anxiety-reduction from the treated to the untreated fear. Morris and Thomas (1973) had reported a similar generalization effect earlier. Calef (1974) noted that with indi-

viduals who are severely distressed an individualized desensitization program would be helpful to augment the grouped presentation.

Comparisons of grouped procedures to individual procedures confirmed that both are effective therapeutic procedures (Scisson and Njaa, 1973; Richardson and Suinn, 1973, 1974). Indications from the later investigation suggested that a careful gradation within the hierarchy may not be necessary in effectively reducing anxiety.

Systematic Desensitization Compared: Systematic desensitization has been compared to several other anxiety reduction procedures. Mylar and Clement (1972) found systematic desensitization and implosive therapy (flooding) to be equally effective in the reduction of public speaking anxiety. However, other studies with test anxiety (Smith and Nye 1973; Cornish and Dilley, 1973) comparing the two procedures found systematic desensitization to be the more effective. Both sets of investigators did suggest that the type of patient and problem were important considerations to be taken into account and suggest that different techniques may affect various response systems differently.

Investigations comparing study counselling and desensitization offered conflicting results with Osterhouse (1972) finding desensitization to be the more effective while Smith, Cunar, and Gilbert (1975) found them to be

equally so. Further research in this area is warranted as a result.

Maleski (1974) found Rational Emotive Therapy (RET) to be consistently more effective in behavioral, affective, and attitudinal changes than was desensitization. Carter and Pappas (1975) found both awareness treatment and desensitization to be equally effective.

In Vivo Desensitization: Systematic desensitization, as described to this point, requires the subject to clearly visualize distressful situations. However, some find this extremely difficult to do. This inability to visualize vividly has been overcome through the use of in vivo desensitization, presentations of actual feared objects or situations. Recent investigations have demonstrated this to be an effective adaptation of the more traditional procedures: Miller (1973) with a 10 year old child along several phobic areas, Gurman (1973) with public speaking phobia, Obler (1973) with sexual dysfunction in which in vivo desensitization proved significantly superior to group therapy, and Kirsch, Wolpin, and Knutson (1975) with stage fright.

All studies suggest, as Gurman (1973) states:

> Although in vivo procedures are sometimes difficult or impossible to arrange, the rapidity of the approach and its enduring and generalized effects appear to recommend it.

In fact, rather than using in vivo treatment only when imaginal desensitization is not productive, studies indicate that traditional desensitization may come to be advocated only when in vivo conditions are impossible to arrange.

Summary of the Literature Review:

Certainly questions have arisen regarding systematic desensitization, its theoretical foundations, procedures and applications. However, its usefulness as a therapeutic procedure in reduction of anxiety remains. Recent studies have led to the development of improved modifications which offer its therapeutic potential to greater numbers of people in a much more efficient manner. Suffice it to say systematic desensitization is not a panacea for all anxiety ills, but it has proven to be a consistently successful treatment for a variety of anxiety responses and as such merits continued use and investigation.

CHAPTER III

PROCEDURE AND DESIGN

In this chapter the methodology employed in the application and assessment of the treatment program is discussed. Attention is directed towards the following: sample, questions, rationale for the questions, hypotheses, research design, assessment procedures and instrumentation, treatment program and hierarchy development.

Sample

The subjects were drawn from an elementary education mathematics methods class. They were drawn on the basis of scores on a Mathematics Anxiety Rating Scale (MARS, Suinn, 1972) given to the class as a whole at the beginning of the school term (See Appendix A for MARS results). It was to those scoring highest, thus defined as "high anxious" within the class population, that the treatment program was offered. Following the same criterion, MARS scores, the remainder of the class was defined as "mid/low anxious", within their class population. For texts of the addresses to the class and to the "high anxious" group see Appendices B and C.

Due to attrition the sizes of the groups formed

changed during the course of the school term from an initial total population of 141 to 104. It was with this latter group that the study was conducted. (See Table 1 for group size and definition).

Table 1

Group Sizes

Initial			
Total Population			141
a) High Anxious		51	
(i) Volunteers		24	
Treatment Group 1 (Group A)	11		
Treatment Group 2 (Group B)	13		
(ii) Non-Volunteers (Group C)		27	
b) Mid/Low Anxious (Group D)		90	
Final			
Total Population			104
a) High Anxious		44	
(i) Volunteers		18	
Treatment Group 1 (Group A)	11		
Treatment Group 2 (Group B)	7		
(ii) Non-Volunteers (Group C)		26	
b) Mid/Low Anxious (Group D)		60	

Participation was on a volunteer basis. Those who did so were randomly assigned to two treatment groups (A and B). Both groups received the systematic desensitization therapy based on an anxiety hierachy constructed from their responses on the MARS. Two three-week treatment per-

iods were conducted. During the initial period one group (A) was to receive treatment while the second group (B) acting as a control for treatment effects, was to receive no treatment. During the second treatment period the initial no treatment control group (B) was to receive treatment.

Questions

The following questions were addressed:

1. Did the two groups differ with respect to mean scores on the anxiety measure (MARS) following the first treatment period?

2. Did the two groups have similar mean scores on the anxiety measure (MARS) following the second treatment period?

3. For both groups, did the mean scores on the anxiety measure (MARS) change significantly between the pre and post treatment administration of the instrument?

4. For the first treatment group (A) were any changes in mean scores on the anxiety measure (MARS) retained over time, as assessed after a follow-up administration of the instrument four weeks after treatment?

5. Were similar effects (with reference to the 4 questions above) noted on the Attitude measures (Aiken Value and Enjoyment Scales)?

6. Did the two treatment groups differ significantly

from the no-treatment high anxious group in their performance in the mathematics methods course as measured by the four quizzes given throughout the term?

Rationale for the Questions

Questions 1 and 2 are important in replicating past success using systematic desensitization to reduce mathematics anxiety. Questions related to question 5 were included to gather further evidence with respect to the effects of systematic desensitization on attitudes in terms of the enjoyment of and perceived value of mathematics.

Besides comparing the two treatment groups (A and B) in terms of the effects of treatment it is of value to understand the degree of change induced by the treatment and its retention over time. Questions 3 and 4 are addressed to these issues. Whether mathematics anxiety and its successful reduction through systematic desensitization treatment alters performance in a mathematics class is of interest to which question 6 responds.

Hypotheses

As an outgrowth of the previous questions the following hypotheses were generated.

Anxiety Factor

1. That for both treatment groups (A and B) there would be changes in their mean scores on the MARS

following treatment as measured by the pre and post test results for both groups. These changes were hypothesized to be in the direction of lowered scores (less anxiety).

2. That for the first treatment group (A) any changes in mean scores achieved on the MARS following treatment (lowered scores, less anxiety) would be maintained over time, as assessed by a follow-up administration of the instrument four weeks after post-test (test occasion III).
3. That the two treatment groups (A and B) would differ in their mean scores on the MARS after the first treatment period during which only the first group (A) received treatment. This hypothesis was assessed by a comparison of the results achieved on the MARS by the two groups over test occasions I and II.
4. That at the conclusion of the second treatment period both treatment groups (A and B) would have similar mean scores on the MARS, as measured by a comparison of the results achieved on the MARS by both groups across test occasions I, II and III.
5. That, over the duration of the mathematics methods course both treatment groups (A and B) would have lowered their mean scores on the MARS whereas the

no-treatment high anxious group (C) and mid/low anxious group (D) would not. A comparison of the results achieved on the MARS by all four groups across test occasions I to III was made to assess the validity of this hypothesis.

6. That at the conclusion of the mathematics methods course both treatment groups (A and B) would achieve similar mean scores on the MARS as compared to the mid/low anxious group (D) whereas the no-treatment high anxious group (C) would have a different mean score (hypothesized to be higher, reflecting a higher level of anxiety). A comparison of the final mean scores achieved on the MARS (test occasion IV) across all four groups was made to assess the validity of this hypothesis.

Attitude Factor:

7. That for both treatment groups (A and B) there would be changes in their mean scores on both the attitude scales (Aiken-Value (A-V) and Aiken Enjoyment (A-E)) following treatment as measured by the pre and post-test results for both groups. These changes were hypothesized to be in the direction of higher scores (improved attitude).
8. That for the first treatment group (A) any change

in mean scores achieved on the Attitude scales (A-V, A-E) following treatment (higher scores, improved attitude) would be maintained over time, as assessed by a follow-up administration of the instruments four weeks after post-test (test occasion III).

9. That the two treatment groups (A and B) would differ in their mean scores on the Attitude scales (A-V, A-E) after the first treatment period during which only the first group (A) received treatment. This hypothesis was assessed by a comparison of the results achieved on the Attitude scales (A-V, A-E) by the two groups over test occasions I and II.

10. That at the conclusion of the second treatment period both treatment groups (A and B) would have similar mean scores on the Attitude scales (A-V, A-E) as measured by a comparison of the results achieved on the Attitude scales (A-V, A-E) by both groups across test occasions I, II and III.

11. That over the duration of the mathematics methods course both treatment groups (A and B) would have increased their mean scores on the Attitude scales (A-V, A-E) whereas the no-treatment high

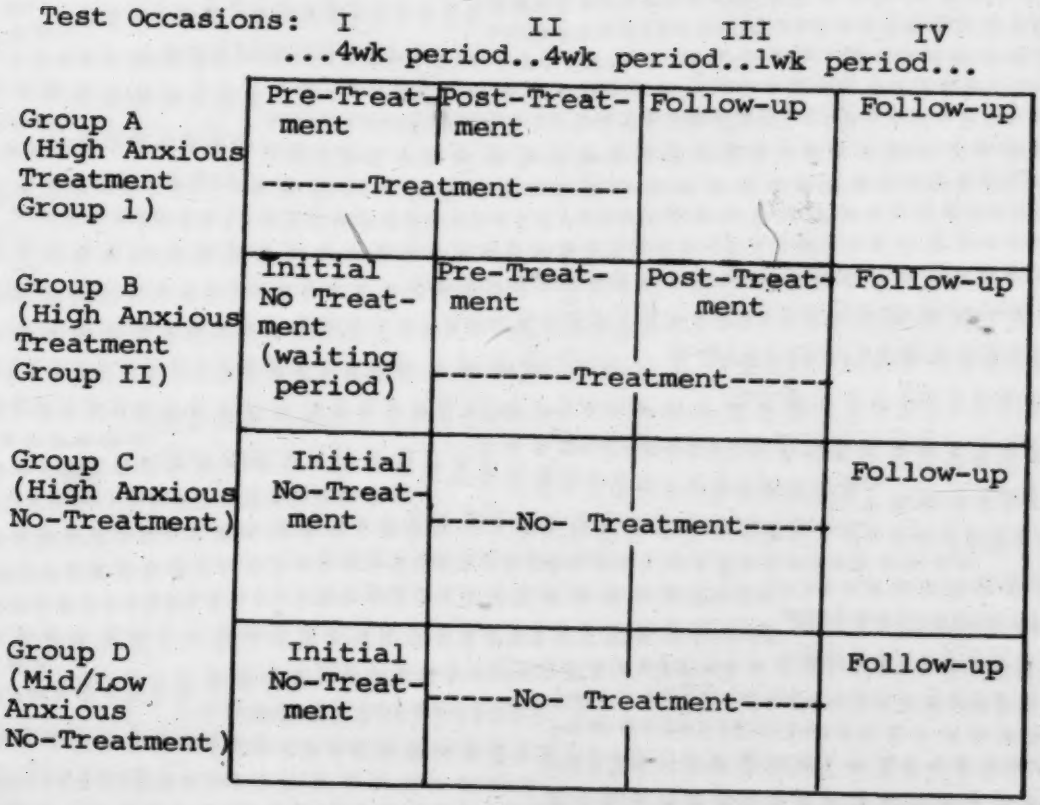
anxious group (C) and the mid/low anxious group (D) would not. A comparison of the results achieved on the attitude scales (A-V, A-E) by all four groups across test occasions I to IV was made to assess the validity of this hypothesis.

12. That at the conclusion of the mathematics methods course both treatment groups (A and B) would achieve similar mean scores on the attitude scales (A-V, A-E) as compared to the mid/low anxious group (D) whereas the no-treatment high anxious group (C) would have a different mean score (hypothesized to be lower). A comparison of the final mean scores achieved on the attitude scales (A-V, A-E), test occasion IV, across all four groups was made to assess the validity of this hypothesis.

Performance Factor

13. That the performance ratings, based on the four quizzes given to four of the five seminar groups through the duration of the course, would not differ significantly across all three groups i.e. both high anxious treatment groups (A and B), no treatment high anxious group (C), and mid/low anxious group (D).

Research Design



Test occasions I and IV all groups (tested together)

II and III Treatment groups A and B only (tested together)

Figure 1. Schedule for Treatment and Testing Anxiety and Attitude Towards Mathematics

The schedule for the presentation of treatment and testing occurred as outlined in Figure 1. On all test occasions both the anxiety measure (MARS) and attitude measures (A-V, A-E) were administered. All four groups,

A, B, C and D, received the test administrations at test occasions II and IV.

The test occasion I was the pre-test for Group A (high anxious, first treatment group), after which they received the treatment program. This became a waiting period for group B, high anxious, second treatment group, providing the opportunity for a treatment/no-treatment comparison of results at test occasion II.

Test occasion III provided an opportunity to assess the possible retention over time (4 weeks) of changes that occurred in Group A following treatment, as well as to assess the possible effect of treatment when applied in the second half of the term to group B (high anxious, second treatment group).

Test occasion IV, given to the total population, allowed a comparison of possible changes in anxiety and attitude between the two treatment groups, A and B, with differing treatment occasions, the no-treatment high anxious group (C), and the mid/low anxious group (D).

Assessment Procedures and Instrumentation

The population was defined as belonging to one of four groups (as determined by the MARS scores) and assessed according to the schedule outlined in Figure 1. Two instruments were administered on all test ocassions to determine the possible effect of the treatment program

on mathematics anxiety and on attitudes towards mathematics. The Mathematics Anxiety Rating Scale (MARS) developed by Suinn (1972), was used to assess the level of mathematics anxiety. The Aiken Attitude Scales developed by Aiken (1974) containing two distinct components of Value and Enjoyment of Mathematics were used to assess the attitude towards mathematics.

A third instrument, administered at the end of treatment, was a Self-Report Questionnaire to assess subjectively, the possible effects of treatment on mathematics anxiety and attitudes toward mathematics.

To assess the possible effect of treatment on performance, the results from four quizzes given during the term to four of the five seminar groups were compared. (see Appendix D)

Mathematics Anxiety Rating Scale

The MARS as developed by Richard M. Suinn (1972) is useful as a diagnostic instrument measuring mathematics anxiety, and is a means for constructing an anxiety hierarchy for systematic desensitization. Following treatment it may be re-administered to determine the effectiveness of a therapeutic program directed towards the reduction of mathematics anxiety.

The MARS is a 94 item self-rating scale. Each item represents a situation incorporating a mathematics-

related activity which may arouse anxiety within the respondent. A five point scale is used to evaluate the level of anxiety felt using the dimensions of "not at all" (value = 1), "a little" (value = 2), "a fair amount" (value =3), "much" (value = 4), or "very much" (value = 5). The respondents are asked to move quickly through each item describing their level of anxiety as it currently exists. The higher the total score the higher (greater) the level of anxiety.

Normative data (Journal of Counselling Psychology, 1973) is available on students from two universities including clients referred for treatment of mathematics anxiety. Sample sizes range up to nearly 400 in number. (see Appendix E)

Reliability data confirms that the test is highly reliable and indicates that the test items are heavily dominated by a single, homogeneous function, presumably mathematics anxiety (Richards and Suinn, 1973). A test-re-test reliability coefficient for the MARS calculated for two classes of university students (N=35 each) over a seven week period (r=.85) compared favourably with reliability over a two week period (r=.78) This was comparable to reliability of other scales frequently used such as the following: .80 for the Taylor Manifest Anxiety Scale; .78 for the Test Anxiety Scale; .68 for the Social Avoidance and Dis-

tress Scale, and .72 for the Fear Survey Schedule (Suinn et al, 1973). An internal consistency reliability coefficient was found to be .97 (N=397) indicating that the average intercorrelation of test items was quite high. Over half of the item total correlations were greater than .50.

Validity data supports the contention that the MARS effectively measures mathematics anxiety. Correlations between the MARS scores and scores on the numbers portion of the Differential Aptitude Test (DAT) range from -.32 to -.64. Since high mathematics anxiety should be associated with lower performance on mathematics tests, the negative correlations suggest that the MARS measures mathematics anxiety (Suinn, 1973). Suinn further reports that clients seen for treatment of mathematics anxiety in three studies showed scores above the standardized norm and following treatment for mathematics anxiety these scores decreased significantly as compared to untreated subjects. Assuming that the treatment did in fact reduce the level of mathematics anxiety, the corresponding reduction in MARS scores may be viewed as providing construct validity for the test.

Aiken Attitude Scales (A-V, A-E)

Aiken (1974) developed a Mathematics Attitude Scale on the premise that a mathematics attitude encompasses

both an enjoyment of mathematics and a perceived value of mathematics. The two scales are administered and scored separately with eleven and ten items comprising the Enjoyment and the Value Scales, respectively.

Approximately half of the items on each scale are worded in the direction of a favourable attitude, the remainder in the direction of an unfavourable attitude. The items present a particular attitude about mathematics to which the respondent indicates his or her position. The response choices, on a five-point scale, range from "strongly agree", "agree", "undecided", "disagree", to "strongly disagree". The scores range from 5 to 1 with the highest score being given to the most positive attitudinal response. Therefore a high score on the two scales (A-V, A-E) would indicate a more favourable (positive) attitude towards mathematics.

In terms of reliability data a high internal consistency reliability coefficient of .95 was achieved for the Enjoyment Scale. A moderately high internal consistency reliability coefficient was obtained for the Value scale of .85. The correlations between the Enjoyment and Value scales was reported at .64, suggesting that though there was considerable overlap between the two scales, they were not measuring identical variables (Aiken, 1974).

Results of correlation analyses suggest that the

two scales are valid measures of mathematics attitude. Indications are that the Enjoyment scale is more highly related to measures of mathematical ability and interest whereas the Value scale is more highly correlated with measures of verbal and general scholastic ability which further attests to the discriminatory validity of the two scales. Correlations of the Enjoyment and Value scales with a Scholastic Aptitude Test of Mathematics were .38 and .27 respectively, significant at the .01 level. Correlations of the Enjoyment and Value scales with a Scholastic Aptitude Test- Verbal was .10 and .35 respectively, with only the latter correlation reaching significance.

Self-Report Questionnaire

The self-report questionnaire, developed by the investigator was devised to assess the effect of the treatment on both anxiety level and attitude towards mathematics as perceived by the subject. The subjects were asked to respond in statement form, to fifteen questions or issues. (see Appendix F). Some of the issues to which attention was drawn included possible alterations in the treatment as presented, difficulties encountered, and possible future applications of the treatment program.

The results obtained were subjectively evaluated by the investigator. Comparisons were drawn within and between the two treatment groups (A and B) regarding both

positive and negative elements in the respondents' comments.

Treatment Program

It was the intent of the investigator to follow the procedural format as outlined by Joseph Wolpe (1973) as closely as possible with some modifications through the use of a standard hierarchy and audio-taped presentation of the relaxation and desensitization procedures. Treatment was to be presented over a 3 week period in nine, one hour sessions following the pretesting using both the anxiety and attitude measures described earlier. See Appendix G for the texts of the individual sessions as presented to each group. A brief summary of these sessions follows:

Session I: The first session incorporated an explanation of the theoretical foundations upon which systematic desensitization is based and an explanation of the processes and procedures involved such as the deep muscle relaxation, visualization of scenes, hierarchy development, and desensitization. This session concluded with an initial experience in deep muscle relaxation.

Discussion of any questions was encouraged to facilitate understanding of the concepts involved prior to the commencement of the program. The critical issue to be understood was that all behaviour is learned and as such maladaptive behaviour can be unlearned, replaced by

new more adaptive behavioural responses to given situations e.g., replace anxiety with deep muscle relaxation.

The first session concluded with practice in deep muscle relaxation, following a tense/relax sequence which Lazaras developed as a modification of Jacobson's relaxation technique. This procedure was used initially to acquaint the subjects with a realistic experience of the difference between the states of tension and relaxation in the major muscle groups of the body. (See Appendix H for the procedure followed). To maintain continuity across all presentations to both groups this tense/relax sequence was presented on audio-tape.

Subjects were advised to practice their relaxation techniques at home twice a day throughout the treatment period with the understanding that skill in relaxation, so crucial to the success of the program, only comes with practice.

Session II: The second and each successive session began by informally sharing experiences with their homework assignments, in this instance, relaxation training. The purpose of this session was to individually rank-order the 18 item standardized hierarchy and to practice the visualization of scenes while in a state of deep muscle relaxation.

It was important to clearly indicate to the sub-

jects that the order of the items in the hierarchy could be altered, if appropriate, at any time throughout the program and scrutiny for possible revisions should be made at the commencement of each session that followed.

Once the hierarchies were organized, deep muscle relaxation, the tense/relax sequence, was induced. While deeply relaxed the subjects were asked to visualize as vividly and clearly as posible various scenes incorporating as many of their senses as possible. The visualization ended with each subject imagining a "special place" of a particularly restful, relaxing nature to which they would visually return at the conclusion of each desensitization session to follow.

The subjects were advised to continue their home practice in deep muscle relaxation as well as to make any revisions to the rank order of items in their hierarchy that appeared appropriate.

Hierarchy Development: The hierarchy contained 18 items, 15 of which were generated from the MARS responses of the high anxious subjects reflecting mathematics situations that had ellicited varying degrees of anxiety within this group. As suggested by Suinn (1972) a balance was struck in developing the hierarchy by identifying three items designated by the high anxious respondents to fall into each of the five categories of anxiety-arousal: "none",

"a little", "a fair amount", "much", and "very much". Three other items were added relating to the teaching of mathematics for which the mathematics methods course was designed. This balance provided a series of situations that had been rank-ordered from low to high in terms of anxiety arousal. In developing an anxiety hierarchy it is crucial to allow for this gradual movement from a situation of no anxiety (or minimal) to the situation of greatest stress, highest anxiety (Wolpe, 1973). The use of a standardized hierarchy was designed to allow for continuity of presentation and progress with and between the groups. Individualization, however, did occur in the rank-ordering of the eighteen items by each subject in both treatment groups.

The hierarchy was presented initially as seen in Appendix I with all items listed on one sheet to allow all the items to be easily compared and ordered. Once desensitization began each subject was given a set of eighteen cards, one for each item in the hierarchy. This allowed for ease in isolating the 3 scenes for each session and in re-ordering scenes when appropriate throughout the program.

Session III: The session began as usual with a brief informal sharing of experiences with the home practice in deep muscle relaxation. During this session the desensi-

tization procedure was introduced which would become the pattern to be followed in each successive session.

To maintain continuity across sessions and for both groups the desensitization procedures were presented on audio-tape. To allow for individual differences in the number of visualizations required to desensitize each scene, allowance was made for visualizing each scene six times for periods of from 5 to 30 seconds with successive 5 second increments in each visualization. Interspersed between each visualization was a forty-five second period of deep muscle relaxation.

The first three scenes, unique for each subject due to individualized rank-ordering of items, were to be the focus of desensitization in this session. Prior to inducing deep-muscle relaxation each scene was visually organized for a few moments to prepare the subjects for visualization. A memory peg, one specific aspect of the particular scene which would visually trigger its immediate recall, was chosen by each subject for each scene. Following deep muscle relaxation, tense/relax sequence, the subjects moved through their first 3 scenes, ending with the visualization of their "special place".

To conclude this session problems in visualization or relaxation were discussed in order to make any necessary alterations that would facilitate the program. The subjects

were encouraged to continue practice in relaxation and to re-order the remaining hierarchy items if appropriate.

Sessions IV through VIII: In the remaining desensitization sessions the following procedures were used: visually preparing the 3 new scenes for the day prior to commencing the program, deep muscle relaxation following a relax only sequence as suggested by Fitzsimmons and Ahronson (1972) (Appendix J) by audio-tape presentation, and desensitization as outlined in Session III beginning with a 30 second visualization of the review scene for the day, the last scene desensitized in the previous session, followed by the 3 new scenes and concluding with the visualization of each "special place". Each session ended with discussion of any problems that had arisen and with a reminder to continue home practice in relaxation technique to develop their relaxation skill.

During these later sessions the informal discussion period was used to share experiences in using their relaxation techniques in real-life situations when they had become conscious of a rising anxiety and tension. This demonstrated that ability to regain self-control was an important and reinforcing element that evolved as the program proceeded.

Session IX: The purpose of this last session was to administer the post-tests using both anxiety and attitude

measures. Both groups attended each of the two post-test sessions. The self-report questionnaires were given to each subject following treatment and post-testing.

CHAPTER IV

RESULTS AND CONCLUSIONS

In this chapter statistical analyses of the results of this study are presented. Initially, each hypothesis is discussed individually, stating appropriate data and resultant conclusions. Responses from the subjective self-report questionnaires are summarized. To conclude, an overall summation of the findings is given.

Anxiety Factor

The results of the anxiety measure (MARS) given to subjects on all test occasions are given in Table 2.

Hypothesis #1

Hypothesis #1 states: that for both treatment groups (A and B) there will be changes in their mean scores on the MARS following treatment as measured by the pre and post-test results for both groups. These changes are hypothesized to be in the direction of lowered scores (less anxiety).

Findings: An analysis of pre-test/post-test scores for both treatment groups indicate a significant reduction in mean scores on the MARS, for Group A (first treatment group), t (11) = 6.850, $p < 0.000$, for Group B (2nd treat-

Table 2

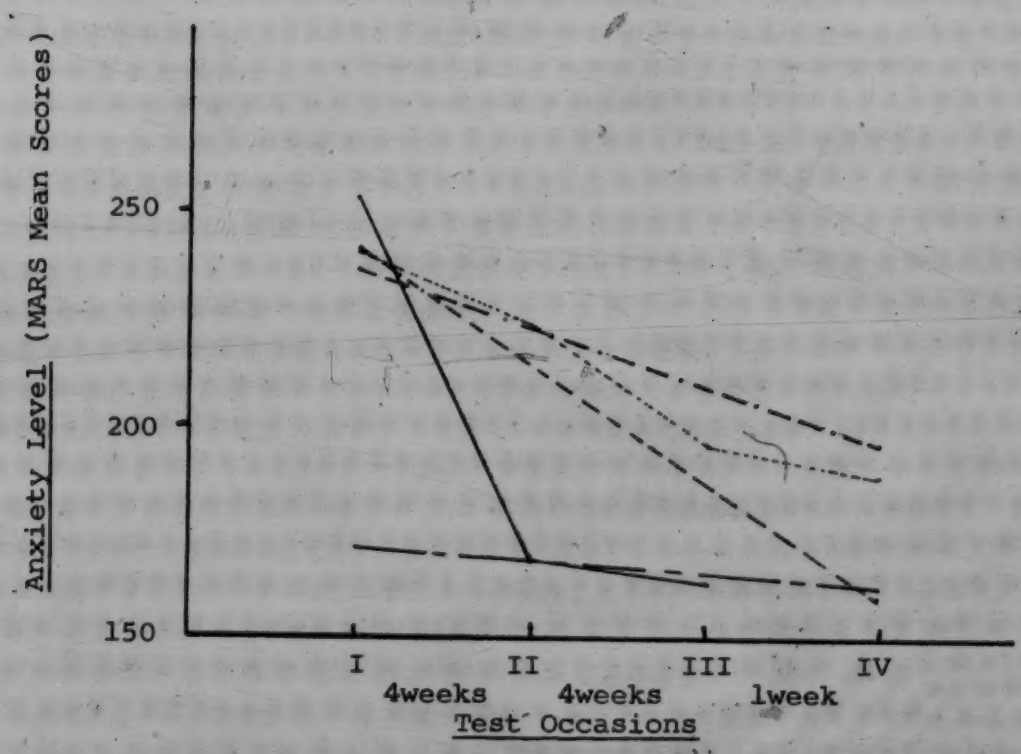
Mean Scores on Anxiety Measure (MARS) Across All Groups, For All Test Occasions

Test Occasion	I	II	III	IV
		4 weeks	4 weeks	1 week
Group A High Anxious 1st Treatment Gp. N=11*	Pre-test 253.7 (*N=8...242.8)	Treatment Post-test 170.7	Follow-up 163.0	Follow-up * 158.1 *N=8
Group B High Anxious 2nd Treatment Gp/ N=7	Initial Waiting Period 242.3	Pre-test 223.3	Treatment Post-test 191.1	Follow-up 188.0
Group C High Anxious No-Treatment N=26	Initial No-Treatment 237.1	---------No-Treatment---------		Follow-up 191.0
Group D Mid/low anxious No treatment N=60	Initial No-Treatment 173.2	---------No-Teatment ---------		Follow-up 162.0

* Note: Number of subjects in Group A changes from 11 to 8 when Test Occasion IV is used as 3 subjects were unavailable at that time for assessment.

Figure 2

Graphic Representation of Mean Scores on the Anxiety Measure (MARS) Across All Groups For All Test Occasions



Group A
High Anxious
1st Treatment
Group (N=11)

Group B
High Anxious
2nd Treatment
Group (N=7)

Group A
High Anxious
1st Treatment
Group (N=8)

Group C
High Anxious
No-Treatment
Group (N=26)

Group D
Mid/Low Anxious
No-Treatment
Group (N=60)

group), t (7) = 3.525, $p < 0.012$. These results suggest that though both treatment groups significantly reduced their anxiety levels they appeared to do so differently. A direct comparison of the pre to post-test results between the two treatment groups (with treatment and testing occurring at different times) supported this view. A two-way analysis of variance with repeated measures indicated significant treatment effects $p < 0.0000050$ with significant interaction $p < 0.008$, evidence of the fact that the treatment effects were different across the two groups.

Conclusion: Hypothesis #1 is tenable in that both treatment groups lowered significantly their level of anxiety following treatment.

Hypothesis #2

Hypothesis #2 states: that for the first treatment group (A) any changes in mean scores achieved on the MARS following treatment (lowered scores, less anxiety) will be maintained over time, as assessed by a follow-up administration of the instrument four weeks after post-test (test occasion IV).

Findings: Actual mean scores across the pre-test, post-test, and follow-up administrations for the first treatment group indicate progressively decreasing mean scores, decreasing level of anxiety. Statistical evidence that the decrease in mean scores was significant and maintained over

time was obtained through an analysis of variance with repeated measures on these test scores. Results indicate that a significant reduction in mean scores occurred and was maintained over the four week follow-up period after treatment, $F = 45.157$, $p(F) < 0.0005$ ($< .01$)

Conclusion: Hypothesis #2 is tenable in that the reduction in level of anxiety achieved following treatment (for Group A) was maintained over time.

Hypothesis #3

Hypothesis #3 states: that the 2 treatment groups (A and B) will differ in their mean scores on the MARS after the 1st treatment period during which only the first group (A) received treatment. The validity of this hypothesis will be assessed by a comparison of the results achieved on the MARS by the 2 groups over test occasions I and II.

Findings: A comparison of changes in mean scores for groups A and B obtained at test occasions I and II, through a two-way analysis of variance with repeated measures, offered evidence that there was a significant reduction in mean scores, $P(F) < 0.0011$ ($< .01$) with a significant interaction $P(F) < 0.0057$ ($< .01$). Thus the reduction in anxiety level between the two test occasions had occurred differently within the two groups, the first group A, receiving treatment, having the lower scores and greater reduction.

Conclusion: Hypothesis #3 is tenable with the two groups A and B differing significantly in their level of anxiety following the first treatment period in which Group A, the treatment group, displayed the more significant reduction.

Hypothesis #4

Hypothesis #4 states: that at the conclusion of the second treatment period both treatment groups (A and B) will have similar mean scores on the MARS, as measured by a comparison of the results achieved on the MARS by both groups across test occasions I, II and III.

Findings: An analysis of variance with repeated measures run individually for each group indicates that both groups achieved a significant reduction in mean scores on the MARS by the conclusion of the 2nd treatment period but at apparently different levels of significance, for group A (N=11) $F = 45.157$ $p(F) < 0.00005$ ($< .01$), and for group B (N=7) $F = 7,386$, $P(F) < 0.0348$ (< 0.01). A direct comparison between the 2 groups (A and B) of the mean scores achieved by the conclusion of the second treatment period was done to clarify this issue.

Statistical analysis through a two-way analysis of variance with repeated measures agrees that both groups (A and B) by test occasion III (having both received treatment) had significantly reduced their mean scores on the

MARS, $F = 36.776$, $P(F) < 0.00000$ (< 0.01). However, there were indications that this effect occurred differently within the two treatment groups as significant interaction occurred, $F = 7.166$, $P(F) < 0.0026$ (< 0.01).

Actual mean scores indicate that the first treatment group (A) achieved lower mean scores, by test occasion III with a greater reduction over the three test occasions.

Conclusions: Hypothesis #4 is not tenable as both treatment groups did not achieve similar mean scores on the MARS by test occasion III, with both having by then, received treatment.

Hypothesis #5

Hypothesis #5 states: that over the duration of the mathematics methods course both treatment groups (A and B) will have lowered their mean scores on the MARS, whereas the no-treatment high anxious group (C) and the mid/low anxious group (D) will not. A comparison of the results achieved on the MARS by all four groups across test occasions I to IV will be made to assess the validity of this hypothesis.

Findings: For this question the number of subjects in the first treatment group had changed from 11 to 8 as a result of the unavailability of 3 group members at test occasion IV. Therefore the results referred to in this instance for group A represent only 8 subjects.

All four groups indicated a reduction in mean scores over the duration of the mathematics methods course. A two-way analysis of variance with repeated measures comparing results achieved on test occasions I and IV across all groups indicated that the reduction in mean scores over the term was at a significant level, $F = 103.309$, $P(F) < 0.0000009$ ($< .01$), that there were significant group effects (the groups being significantly different from one another,) which was so by definition, $F = 6.381$, $P(F) < 0.005$ (< 0.01), and that there was a significant interaction, $F = 9.806$, $P(F) < 0.00001$ (< 0.01) which suggests that the significance of the reduction in mean scores between the two test occasions had occurred differently across the four groups. Further analysis using Scheffe's multiple comparisons (Ferguson, 1973) was done to clarify where the significance lay (see Table 3 for Scheffe Comparison results).

Table 3

Scheffe Comparisons of Changes in Mean Scores on Anxiety Measure (MARS) for all Groups from Initial to Final Test Occasions (I-IV)

Groups - Test Occasion I	Groups - Test Occasion IV			
	A-IV	B-IV	C-IV	D-IV
Group A-I (N=8)	49.79*			
Group B-I (N=7)		17.89*		
Group C-I (N=26)			48.52*	
Group D-I (N=60)				6.80

Critical $F' = 8.1$ Significance Achieved...*

Note: Scheffe error term was derived from the ANOVA program run initially to determine main effects (Winer, 1971)

The results achieved in the Scheffe comparisons suggest that significant changes (reductions) in mean scores on the MARS occurred across all high anxious groups (A, B and C) with no significant change occurring within the mid/low anxious group (D) as expected. A note of caution should be taken however for with the larger number of subjects in the no-treatment high anxious group (C) as compared to the two treatment high anxious groups (A and B) a lower reduction in mean scores would be required to reach significance.

Conclusion: Hypothesis #5 is not tenable for the no-treatment high anxious group (C) significantly lowered their mean scores on the MARS over the duration of the course as well as did the two treatment groups.

Hypothesis #6

Hypothesis #6 states: that at the conclusion of the mathematics methods course both treatment groups (A and B) will achieve similar mean scores on the MARS as compared to the mid/low anxious group (D) whereas the no-treatment high anxious group (C) will have different mean scores (hypothesized to be higher reflecting a higher level of anxiety). A comparison of the final mean scores achieved on the MARS (test occasion IV) across all four groups will be made to assess the validity of this hypothesis.

Findings: For this question the number of subjects in the first treatment group had changed from 11 to 8 as a result of the unavailability of 3 group members at test occasion IV. Therefore the results referred to in this instance for group A represent only 8 subjects.

The final mean scores achieved by the four groups indicated that the group scoring at the highest level of anxiety was the no-treatment high anxious group (C), followed in declining order by the second treatment group (B), the mid/low anxious group (D) and at the lowest level of anxiety the first treatment group (A).

Statistical analysis of the final mean scores on the MARS achieved by all four groups, through Scheffe's method of multiple comparisons revealed the following results as outlined in Table 4.

Table 4

Scheffe Comparisons of Final Mean Scores (test occasion IV) on the Anxiety Measure (MARS) Across all Groups

	Group A	Group B	Group C	Group D
Group A (N=8)		5.79	11.52*	0.19
Group B (N=7)			0.09	7.38
Group C (N=26)				27.02*
Group D (N=60)				

Critical F′= 8.1 Significance Achieved...*

Note: Scheffe error term was derived from the ANOVA program run initially to determine main effects (Winer, 1971).

A significant difference in the final mean scores on the MARS occurred between the no-treatment high anxious group (C) and the mid/low anxious group (D) with the no-treatment high anxious group having the significantly higher mean scores. Neither of the 2 treatment groups (A or B) displayed significantly different mean scores as compared with the mid/low anxious group (D).

A further result indicated a significantly higher mean score (level of anxiety) for the no-treatment high anxious group (C) when compared to the first treatment group (A) which registered the lowest level of anxiety among all four groups.

Conclusion: Hypothesis #6 is tenable. At the conclusion of the mathematics methods course only the no-treatment high anxious group (C) significantly differed in mean scores (significantly higher as hypothesized) on the MARS from the mid/low anxious group (D).

Attitude Factor

The results of the attitude measures (A-V, A-E) administered on all test occasions are given in Table 5.

Hypothesis #7

Hypothesis #7 states: that for both treatment groups (A and B) there will be changes in their mean scores on both the attitude scales (A-V, A-E) following treatment

Table 5

Mean Scores on Attitude Measures Across All Groups, For All Test Occasions

	Test Occasion I (4 week period)	II (4 week period)	III (1 week period)	IV
Group A (High Anxious, 1st Treatment Group) N=11	Pre-test 33.73 / 32.82 (N=8 / N=8 34.63) 32.60)	Post-test 35.46 / 33.18	Follow-up 38.46 / 35.73	Follow-up *37.13 / *(N=8) *34.13
Group B (High Anxious, 2nd Treatment Group) N=7	Initial Waiting 35.71 / 35.57	Pre-test 35.71 / 32.57	Post-test 38.00 / 34.14	Follow-up 36.71 / 34.14
Group C (High Anxious, No-treatment Group) N=26	Initial No-treatment 36.54 / 37.27	-------No Treatment----------		Follow-up 36.35 / 38.19
Group D (Mid/low Anxious, No Treatmnet) N=60	Initial No-treatment 36.50 / 39.22	-------No Treatment----------		Follow-up 36.80 / 39.58

Treatment

Notations are as follows: Aiken Value Scale ...V
Aiken Enjoyment Scale ...E

V / E

*(N=8) Group A ... numbers change from 11 to 8 when using data for test occasion IV alone or in comparison to Occasion I due to the unavailability of 3 of the subjects during test occasion IV. Date collected at these times reflect only the scores collected for N=8

as measured by the pre and post-test results for both groups. These changes are hypothesized to be in the direction of higher scores (improved attitude).

Findings: An analysis of pre-test/ post-test results for both treatment groups indicate an increase in mean scores in terms of perceived Value of and Enjoyment of mathematics (a more positive attitude). However, only in terms of perceived value within the second treatment group (B) are these changes at a statistically significant level, $\underline{t}$ (N=7) = -3.06, $p < 0.022$ (see Table 6 for these results using t tests of significance).

Table 6

Treatment Effects on Attitudes towards Mathematics (Aiken-Value, Aiken-Enjoyment Scales) as Measured by t-test Comparisons across both Treatment Groups (A and B) Following Treatment

	Aiken-Value	Aiken-Enjoyment
Group A (high anxious 1st Treatment Group) N=11	$\underline{t} = -1.867$ $p < 0.091$	$\underline{t} = -0.214$ $p < 0.835$
Group B (high anxious 2nd Treatment Group) N=7	$\underline{t} = -3.060$* $p < 0.022$*	$\underline{t} = -1.704$ $p < 0.139$

* Significance Achieved

Note: t-test, p(2-tailed)
sign ($\pm$) indication of directionality
+ ..decrease in score
- ..increase in score

These results suggest that not only did the two treatment groups appear to differ in the effect on the attitude measures, there were differences in the effects on the two components within the attitude measures.

Further analysis, directly comparing the mean scores achieved on the attitude measures for the two treatment groups revealed similar results. A two-way analysis of variance with repeated measures indicated significant effects occurring only with improved perception of the value of mathematics $p < 0.007$ ($< .01$) with no significant interaction occurring, $p < 0.668$ ($< .01$). This indicates that the significant improvement in mean scores for the value scale was similar across both treatment groups. Though changes occurred in the enjoyment scale following treatment (improved scores) none were significant with no significant interaction occurring, the effects being similar within the two treatment groups.

Conclusion: Hypothesis #7 is not supported. Though changes in mean scores on the attitude scales occurred in the direction hypothesized significance was not reached across both groups for the two scales.

Hypothesis #8

Hypothesis #8 states: that for the first treatment group (A) any changes in mean scores achieved on the Attitude scales (A-V, A-E) following treatment (higher scores,

improved attitude) will be maintained over time, as assessed by a follow-up administration of the instruments four weeks after post-test (test occasion III).

Findings: Actual mean scores across the pre-test, post-test, and follow-up administrations of both instruments for the first treatment group (A) indicate a progressively increasing mean score for both attitude measures. Statistical evidence of such change was obtained through an analysis of variance with repeated measures on these two scales (A-V, A-E). However, results indicate that only in the perceived value scale did improvement reach a level of significance, $F = 3,8496$, $P(F) < 0.03852$ ($< .05$). Changes in the enjoyment scale results, though improved, did not reach a level of significance, $F = 1.7675$, $P(F) < 0.19641$ ($< .05$).

Conclusion: As only the changes in perceived value mean scores reached significance hypothesis #8 is not supported.

Hypothesis #9

Hypothesis #9 states: that the two treatment groups (A and B) will differ in their mean scores on the Attitude scales (A-V, A-E) after the first treatment period during which only the first group (A) receives treatment. The validity of this hypothesis will be assessed by a comparison of the results achieved on the attitude scales (A-V, A-E) by the two groups over test occasions I and II.

Findings: A comparison of the mean scores for groups A and B obtained at test occasions I and II, across both attitude scales (A-V, A-E) offered evidence that suggests a difference did occur between the two groups (A and B) on both attitude measures. The first treatment group (A) indicated an improvement in both perceived value and enjoyment of mathematics following treatment (with increased mean scores). Over the same time period the 2nd treatment group (B), as yet not receiving treatment, showed no change in perceived value and a reduction in enjoyment (see Table 5).

However, statistical analysis through a two-way analysis of variance with repeated measures, indicated that none of the changes in mean scores on the attitude measures reached a level of significance. Though attitudes changed (improved) within the group receiving treatment they did not do so at a statistically significant level.

Conclusion: Hypothesis #9 is not supported as the mean scores achieved on the attitude measures did not significantly differ between the two groups A and B following the first treatment period.

Hypothesis #10

Hypothesis #10 states: that at the conclusion of the 2nd treatment period both treatment groups (A and B) will have similar mean scores in the attitude measures

(A-V, A-E), as measured by a comparison of the results achieved on these instruments by both groups across test occasions I, II, and III.

Findings: An analysis of variance with repeated measures run with each treatment group individually across the three test occasions indicates that a significant change (improvement) occurred only within the first treatment group (A) and only in terms of their perceived value of mathematics, $F = 3.849$, $P(F) < 0.038$ ($< .05$). A direct comparison between the two groups (A and B) of mean scores achieved by the conclusion of the second treatment period was done to clarify the situation further.

A two-way analysis of variance with repeated measures confirms the above findings in that only on the value measure were significant treatment effects achieved, $p = 0.008$. There was, however, no significant interaction recorded between groups (A and B) and treatment effects which suggests that there was no significant difference between the 2 groups in terms of improved attitude on this component. On the enjoyment component no statistically significant differences occurred across the treatment period or between the groups. (See Table 7 for results of this analysis).

Table 7

Two-Way Analysis of Variance with Repeated Measures Comparing Treatment Effects Between the Two Treatment Groups A and B Across Test Occasions I, II and III (after Treatment)

Aiken-Value Scale		
	Treatment Effects	$p < 0.008$*
	Group Effects	$p < 0.546$
	Interaction	$p < 0.509$
Aiken-Enjoyment Scale		
	Treatment Effects	$p < 0.216$
	Group Effects	$p < 0.952$
	Interaction	$p < 0.164$

Significance Achieved*

Conclusion: Hypothesis #10 is tenable, though only the Value component of the attitude measures recorded a significant improvement over the treatment period, both groups achieved similar mean scores on the two components.

Hypothesis #11

Hypothesis #11 states: that over the duration of the mathematics methods course both treatment groups (A and B) will have increased their mean scores on the attitude measures, whereas the no-treatment high anxious group (C) and the mid/low anxious group (D) will not. A comparison

of the results achieved on the attitude measures (A-V, A-E) by all four groups, across test occasions I to IV will be made to assess the validity of this hypothesis.

Findings: For this question the number of subjects in the first treatment group had changed from 11 to 8 as a result of the unavailability of 3 group members at test occasion IV. Therefore the results referred to in this instance for group A represent only 8 subjects.

The results achieved indicate differences in response to the 2 attitude scales across the groups. As predicted both treatment groups (A and B) increased (improved) their mean scores in terms of perceived value of mathematics, whereas the no-treatment high anxious group (C) did not; (in fact they indicate a slight reduction in mean score). The mid/low anxious group (D) recorded a very slight increase in mean score.

On the enjoyment scale results indicated that all groups but the 2nd treatment group (B) recorded an increased (improved) mean score.

Statistically, through a two-way analysis of variance with repeated measures, any changes that occurred across the duration of the mathematics methods course in terms of attitude measures (value or enjoyment) were not at a significant level. (See Table 8 for the results of the statistical analysis).

Table 8

Two-Way Analysis of Variance with Repeated Measures: A Comparison across all Groups on Attitude Measures (Aiken-Value, Aiken-Enjoyment) from Initial to Final Test Occasions (I to IV)

Aiken Value Scale	
Group Effects	$p < 0.960$
Treatment Effects	$p < 0.091$
Interaction	$p < 0.305$
Aiken Enjoyment Scale	
Group Effects	$p < 0.110$
Treatment Effects	$p < 0.669$
Interaction	$p < 0.626$

None Significant

Conclusion: Hypothesis #11 is not tenable as no statistical support was achieved.

Hypothesis #12

Hypothesis #12 states: that at the conclusion of the mathematics methods course both treatment groups (A and B) will achieve similar mean scores on the Attitude measures (A-V, A-E) as compared to the mid/low anxious group (D), whereas the no-treatment high anxious group (C) will have different mean scores (hypothesized to be lower reflecting a less positive attitude). A comparison of the final mean scores achieved on the attitude measures (test

occasion IV) across all four groups will be made to assess the validity of this hypothesis.

Findings: Actual scores on the two attitude measures (A-V, A-E) indicate all groups having similar mean scores on the perceived value scale with the highest being the first treatment group (A) and lowest being the no-treatment high anxious group (C). However, the range between the highest and lowest score is slight (.78).

On the enjoyment scale both treatment groups (A and B) recorded similar mean scores and at a level lower than both the no-treatment high anxious group (C) and the mid/low anxious group (D) which were similar. The range of mean scores highest (Group D) to lowest (Group A) though small was substantially greater than with the value scale (5.15). (See Table 5 for the actual mean scores received for each group)

Statistical analysis confirmed that there were no statistically different mean scores on either attitude scale between the four groups by the conclusion of the course.

Conclusion: Hypothesis #12 is not tenable as no statistical support was achieved.

Performance Factor

Hypothesis #13

Hypothesis #13 states: that the performance rat-

ings (based on four quizzes given to four of the five seminar groups) will not significantly differ across all three groups (both high anxious treatment groups (A and B), no-treatment high anxious group (C), and mid/low anxious group (D)).

Findings: Due to the organization of the mathematics methods course, such that only four of the 5 seminar groups received the 4 quizzes, only 78 of the 104 subjects were considered in the peformance comparisons. With four professors involved in presenting the seminars (representing 30% of the total course time) a statistical analysis was done comparing the three groups (as outlined in the hypothesis) across the four professors to account (statistically) for any possible variance due to differences in instruction.

The statistical analysis through a two-way analysis of variance indicates there was no significant group effect (difference occurring among the 3 groups), no significant professor effect (differences occurring among the 4 professors) and no significant interaction between group and instructor. (See Table 9 for the results of the comparisons done).

Conclusion: The statistical evidence does not suggest that any significant differences in performance ratings occurred across the 3 groups. Hypothesis #13 is therefore supported.

Table 9

Performance Comparisons Across Professors for the 3 Groups

Professors	Groups: High Anxious Treatment (A+B)		High Anxious No-Treatment (C)		Mid/Low Anxious (D)	
I	57.5	N=2	75.0	N=4	75.4	N=12
II	65.8	N=6	71.7	N=3	75.0	N=14
III	65.0	N=2	69.4	N=8	73.1	N=13
IV	76.7	N=3	72.0	N=5	77.0	N=6

Note: Mean Scores based on 4 quizzes weighted equally for a total of 100 marks.

Statistical Analyis: Two-Way Analysis of Variance

(unweighted means method for unequal cell sizes)

Group Effect	$p < 0.201$	
Professor Effect	$p < 0.694$	
Interaction	$p < 0.921$	None Significant

Self-Report Questionnaires

Responses on the self-report questionnaires, given to both treatment groups at the conclusion of the treatment period (folowing post-test administrations), indicated similar subjective evaluations of the success of the treatment

program and its possible effect on both the perceived level of anxiety towards mathematics and on the attitudes toward mathematics.

All considered the experience of participating in the treatment program enjoyable and stimulating. A few reported having an initial apprehension and scepticism about the program which gradually subsided. One respondent from the second treatment group considered the three weeks of treatment sessions somewhat time consuming as university pressures were great. A general feeling of sharing a mutual problem somehow seemed to lessen the anxiety felt. "The knowledge that I wasn't alone in my anxiety." It seemed important that the fears were being exposed, "brought out into the open and faced".

The participants expressed the beneficial effects to themselves in a variety of ways with most agreeing on all the aspects mentioned. The benefits expressed were as follows: a useful technique was learned to be available to them whenever needed quite beyond just mathematics situations that were stressful; to control nervous energy, anxieties "to put anxiety into perspective"; a useful technique to apply to any real-life stressful situation; to aid in sleeping at night "now I can go off in 10 minutes flat"; to generally feel calmer.

As to the program itself, as presented, several

comments were forthcoming. All agreed the relaxation technique was easy to learn, skill developed quickly with practice, able to achieve deeper relaxation more easily, more quickly. It was generally agreed the relaxation/only sequence could be learned quickly.

The visualization of scenes was considered to be more difficult to achieve requiring discipline to concentrate. It was important to make the scenes more personal and more real to facilitate visualization. The preparation of the scenes prior to desensitization was mentioned often as very important with the "memory peg" a useful device.

During desensitization all agreed that as the most stressful scenes were faced they noticed the feelings of anxiety and their gradual reduction through the desensitization process. The experience, for some, was seen as highlighting the "realization of the power of relaxation to reduce the tension felt". This knowledge proved to be a powerful reinforcer for some.

General comments regarding the program as presented stressed the importance in understanding the concepts behind the procedures prior to beginning, in explaining the normality of fears, and in explaining past results and successes as highly reinforcing. A couple of respondents from the second treatment group suggested the treatment should be offered early in the school term and be presented

in a whole group.

As to the participants perceived effectiveness of the treatment program on their mathematics anxiety, all responded positively. This view was expressed in a variety of ways such as the following: the anxiety towards mathematics was brought "into my own control"; there was a generalization towards other anxieties; several experienced real-life situations in which they applied their relaxation technique successfully (In Vivo desensitization); and a general feeling that they could use their new relaxation skills when conscious of rising anxiety, stress or tension occurring in their daily lives.

In terms of effecting their attitude towards mathematics the only comments forthcoming focussed on the enjoyment, or rather lack of it, of mathematics. All participants described feelings of uneasiness, fear, dislike, anxiety, or frustration towards mathematics. Most felt there had been changes but the effects were cautionary in nature, "easier to remove my frustrations", less uptight, less threatening, less afraid, less nervous, improved but "I still don't like it". A couple of respondents noted their particular experience in the following manner: "I have become more comfortable. Maybe it could become interesting", "I can accept my best efforts now even though my grades haven't really improved."

There was a feeling expressed by a few that the experience in the course had been a helpful component in developing more enjoyment out of the particular mathematics situations in which they were focussing.

All participants agreed the treatment program (or one like it) should be made available to future mathematics methods classes as well as to other university students who may need help in combatting their anxieties. They expressed the opinion that the skills learned would be a useful technique to reduce every day tensions and very applicable to real life beyond university situations. The program was viewed as offering a powerful skill in self-management, to bring one's anxieties under self-control.

Summary of Results

The treatment program as presented, proved to be a successful therapeutic procedure in the reduction of mathematics anxiety. Attitudes toward mathematics were altered somewhat, particularly in terms of the perceived value of mathematics but the effect of treatment in this regard appeared to be generally less than significant. There was no apparent effect on performance.

Objective assessment of the treatment program through statistical analyses suggested the following conclusions. The treatment program effectively reduced the

level of anxiety for both treatment groups but to a greater degree for the group receiving treatment first, early in the term. This significant reduction in anxiety was retained over a 4 week follow-up period.

Though the high anxious no-treatment group reported a significant reduction in mathematics anxiety level as well, the actual level of anxiety achieved by this group at the conclusion of the term was significantly higher than both the first treatment group and the mid/low anxious group.

By the end of term the reported level of anxiety achieved by both treatment groups was similar to that achieved by the mid/low anxious group. The group receiving treatment first (who at the initial assessment were at the highest level of anxiety) recorded the lowest level of mathematics anxiety by the conclusion of the course.

In terms of the effects on attitudes towards mathematics the results indicate a somewhat consistent difference in effect on the two attitude components - enjoyment and value, across all groups tested, with the latter of the two components appearing to be the more effected by treatment.

On the value component the following results occurred. Both treatment groups reported an improved attitude immediately after treatment. Over the duration of the pro-

gram and the course only these two groups recorded an improved attitude. However, a statistically significant improvement in perceived value of mathematics was achieved only by the group receiving treatment first. Neither the mid/low anxious group nor the high anxious no-treatment group recorded a significantly improved attitude in this regard.

On the enjoyment component the following results occurred. Changes were minimal across all groups. Though the first treatment group recorded an actual increase in enjoyment the results achieved by the end of term were not statistically significant. The group receiving treatment second showed no change. Both treatment groups viewed mathematics as less enjoyable than the other two groups though the differences between them were not statistically significant.

Subjective assessment of the treatment program through self-report questionnaires, basically lent support to the findings of the objective statistical analyses. Both treatment groups perceived themselves as having significantly reduced their level of mathematics anxiety.

Though fluctuating as to the degree of enjoyment or lack of enjoyment of mathematics as perceived by the subjects, all generally agreed that changes were slight, that their initial lack of enjoyment remained but to a lesser

degree as a result of treatment and too as a result of experience in the mathematics methods class. No specific mention was made as to the perceived value of mathematics.

CHAPTER V

DISCUSSION AND IMPLICATIONS

In this chapter the focus will be on a discussion of this study, elaborating beyond these findings to outline implications for further research regarding the reduction of mathematics anxiety. Issues to which this chapter is addressed are as follows: Systematic Desensitization--the effectiveness of systematic desensitization treatment; qualitative differences in the program as presented; future implications: Other Issues to be Considered-- attitudes and anxiety towards mathematics; performance; volunteers and non-volunteers; and Further Research Directions. A concluding section will briefly summarize the results of this study.

Systematic Desensitization

Effectiveness of the Treatment: The systematic desensitization treatment effectively reduced anxiety towards mathematics. Though a regression towards the mean is to be expected with repeated measures, for all subjects regardless of group placement or treatment, the reduction achieved by the two treatment groups were statistically significant.

However, statistically significant reductions also occurred within the high anxiety group who did not receive treatment, the implication being that experience in the mathematics methods course in itself provided a type of in vivo desensitization, effectively reducing the level of mathematics anxiety.

This raises a serious question as to the validity of claiming the therapy's effectiveness in the reduction of mathematics anxiety. Perhaps this reduction in anxiety occurred merely through the experience of class participation as with the non-treated high anxious group?

On closer scrutiny other issues tend to clarify this point. Due to the larger number of subjects (N=26) in the no-treatment high anxious group as compared to the two treatment groups (N=8, N=7) over the duration of the course, the actual reduction in mean scores for the no-treatment high anxious group would not have to be as great to reach significance as compared to the other two groups.

When comparing the final mean scores achieved by all four groups there is a clear indication of the effectiveness of the treatment program. By the conclusion of the term both treatment groups had achieved a level of anxiety comparable to the mid/low anxious group whereas the no-treatment high anxious group had not. The no-treat-

ment high anxious group concluded the term with mean scores at a statistically significantly higher level than either the mid/low anxious group or the first treatment group. By the term's end the first treatment group had moved from being at the highest level of anxiety recorded to the lowest with a mean score below the class mean.

Thus the treatment program offered was effective in reducing mathematics anxiety. Experience in the mathematics methods course was effective also but to a lesser degree in terms of the amount of reduction of anxiety and the final level of anxiety achieved by the end of the term.

Qualitative differences in the treatment progam as presented: Though both treatment groups achieved a significant reduction in anxiety level, reaching a level comparable to that of the mid/low anxious group by the end of the term they did so to differing degrees. The group receiving treatment first achieved a more dramatic result (though not at a statistically significant level) demonstrating a greater degree of anxiety reduction and lower level of anxiety by the end of term, as compared to the group receiving treatment second.

The statistical analysis thus suggests that differences that may have occurred between the two treatment groups themselves appear to have altered the effectiveness of the treatment program.

The treatment program as outlined in Chapter III was applied to both groups such that the only essential difference was to be the time of treatment. However, due to circumstances beyond the control of the investigator several other discrepancies between the two treatment groups occurred.

The length of the treatment period (3 weeks) was extended over a 4 week period for both groups with a week between pre-test and commencement of the program occurring during the first treatment period. However, during the 2nd treatment period, due to the intrusion of Reading Week when the program was suspended, the treatment program itself was interrupted, delaying the presentation of the final two desensitization sessions and post-test for one week. It was during this interruption that three members of the 2nd treatment group withdrew due to reported time pressures with exams approaching.

The first group met as a whole consistently throughout the program, on the same days, at the same time each week. With individual scheduling problems as a result of time conflicts the subjects in the second group were unable to meet in one large group. Within the second group each subject, though receiving three 1 hour sessions per week, did so at times of the day and on days of the week which varied from subject to subject. The group mem-

bers ranged on occasion from 6 to 1 with an average of 8 different groups being formed over the course of the 3 weeks of presentation. Individuals were seldom with the same group members on any consistent basis.

In summary, what was readily achieved within the first treatment group and appeared to be lacking in various degrees within the second treatment group were group cohesiveness, comraderie among the members, a developing closeness between the therapist and subjects, group sharing of personal experiences using their new skills in real life situations, and a relaxed anticipation of each session. With only a few members of the second treatment group, who rather consistently met together, did there appear to be the development towards achieving this same group cohesiveness and support. The therapist as well, found it more difficult to develop a closeness with the 2nd treatment group, but rather achieving a more individual relationship with most group members.

The subjective self-reports tended to lend credence to the importance of these effects as well. The cohesiveness and group support, sharing of personal experience, the knowledge that "others suffered too", were mentioned by all in the first treatment group as being important elements in their program. A couple of respondents in the second treatment group alluded to these issues by

suggesting that in future the program should be run with the participants working as a group. It was also mentioned that treatment should be made available at the outset of the course.

Future implications: The implications drawn from these findings are that systematic desensitization is an effective treatment program and should be made available to future students exhibiting mathematics anxiety or any other debilitating anxiety. However the most effective presentation of such a program would incorporate the following: 1) Present the program at the beginning of the academic term. 2) Working consistently within a group is to be encouraged such that group members can be supportive to one another. 3) An important component of the program is developing an understanding of the theoretical foundations and procedures involved prior to commencing the treatment. 4) Home practice in relaxation is crucial. 5) Experience in using the skills being developed, in everyday situations, should be encouraged throughout the program as a powerfully reinforcing device.

The viability of altering Wolpe's original methodology was substantiated, through use of automation, a common hierarchy, and grouped presentation, which suggest that further innovations are possible and merit consideration in future investigations.

A treatment program offering systematic desensitization therapy with an easily applied format would appear to be an appropriate response to the findings of this study. Such a program would be a completely automated, self-regulating procedure through the use of audio-tape and instructional guides indicating the sequence of presentation which would incorporate the use of detailed formats for the development of the various aspects of the program. Such a self-regulating program might approximate the following:

1. An Index of Procedures and Sequence to Follow.

2. Initial Anxiety Assessment. A booklet providing a variety of anxiety measures such as general anxiety, revised Willoughby Questionnaire for Self Administration (Wolpe, 1973), Fear Survey Schedule by Wolpe and Lang in 1969 (Wolpe, 1973), mathematics anxiety, MARS (Suinn, 1972), and test anxiety, Inventory of Test Anxiety revised by Osterhouse (1972) is available. Once an appropriate test is chosen and answered the results are to be submitted to a program supervisor (available as a consultant) for grading.

3. Theoretical Foundations of Systematic Desensitization. A booklet, or video-tape (if available) is to be offered briefly explaining the concept of learning and behavior upon which Systematic Desensitization is based

(Wolpe, 1973).

4. Systematic Desensitization Procedure Explained. A booklet or video-tape (if available) is to be offered briefly explaining the procedures and how each works in terms of the theoretical base from which Wolpe developed the procedure. Included will be the use of relaxation, hierarchy items, and desensitization procedures.

5. Development of the Hierarchy. A booklet is to be available briefly outlining the rationale behind the hierarchy and how one is developed, including sample hierarchies on a variety of themes. Issues included would be moving through graduated steps from least to most anxiety arousing situation with variations along one theme, and situations should include spatial (gradually closer positionally, to the most stressful situation) and temporal (gradually closer in time to the most stressful situation) components if appropriate. It would be noted that new situations could be added whenever needed along the way, and can be re-ordered at any time if appropriate.

6. Relaxation Training. Two audio-tapes to be available, one in the tense/relax sequence to acquaint the subject(s) with the difference between these two states and a second with a relaxation only sequence to be used once the subject(s) feel they are able to relax readily, at will. Home practice twice a day throughout the program is ecour-

aged as is application of their relaxation skill in everyday stressful situations.

7. Visualization of Scenes. An audio-tape procedure is to be available offering practice in visualization of scenes that are not stressful with the concluding scene to be one special personal place of relaxation. Each subject is encouraged to make the visualization as vivid, clear, and personal as possible incorporating as many of the senses as possible.

8. Desensitization Procedure. A booklet is to be available with procedural instructions given.

a) prepare the 3 hierarchy scenes for this session briefly, choosing a memory peg, one aspect of the scene that will bring the scene back to mind quickly.

b) play the relaxation tape (tense/relax or relax only - subject's choice)

c) play the desensitization tape

... 3 scenes over 6 visualizations each from 5 to 30 seconds with 5 second gradations, each visualization to be interspersed with 45 seconds of relaxation.

... concluding each session with visualization of the relaxing "special place"/

9. Re-Assessment of Anxiety Level: Once desensitization of all hierarchy items is complete, assessment of the level of anxiety felt with the same anxiety instrument as used at the commencement of the program should be done. Submit the results to the program supervisor for

grading and statistical analysis of the results achieved through a comparison of pre-treatment and post-treatment scores.

A program such as outlined above, would offer an efficient application of systematic desensitization therapy available for individual or group use to which Dawley (1974) alluded through use of patient administered desensitization in a psychiatric ward and Arkowitz (1975) over a two and one half year follow-up period. The program being self-sufficient and self-regulating, a supervisor would be necessary only on a consultant basis for clarification purposes and the grading and evaluation of the anxiety assessments. The program would be available at the subjects' convenience, offering the possibility of a remediation of anxiety that is simple, effective, economic and immediate.

Another application of the systematic desensitization therapy that merits attention and which addresses itself to the issue of expediency of treatment involves further modification of Wolpe's techniques (1973), a grouped, massed and accelerated systematic desensitization procedure.

This program necessitates the availability of a therapist to direct the program. The differences incorporated in this program as compared to Wolpe's postulations

(1973) involve the use of a common hierarchy as demonstrated by Zenmore (1975) and Deffenbacker (1975), with a minimal number of items, significantly fewer in number with a larger gradation between them than Wolpe suggests, and desensitization occurring for all items in the hierarchy over one or two lengthy sessions, for which 4-6 hours would be considered average.

This type of program has been successfully applied to a variety of anxiety situations to anxiety with student nurses (Dawley and Wenrich, 1973), to test anxiety (Barabasz, 1973; Deffenbacker, 1974; Halland Henkle, 1972), and to public speaking anxiety (Parker, 1975) to name a few of the more recent studies run.

Other Issues to be Considered

Attitudes and Anxiety Towards Mathematics: The results of this study tend to confirm Aiken's belief that attitudes towards mathematics comprise more than one component, of which he suggests there are two, value and enjoyment. Only the value component appeared to be susceptible to the effects of treatment in this study.

Speculations as to why this occurred can be made. With the enjoyment component correlating with an interest and ability in mathematics, as Aiken postulates, it would seem plausible that anxiety in mathematics and the reduc-

tion of same would not noticeably alter one's ability or interest in mathematics. Therefore the treatment would not logically cause any noticeable change in the level of enjoyment, perhaps explaining the results achieved in this study.

The value component, as Aiken suggests, correlates with verbal and general ability. It would seem reasonable to assume that in these areas anxiety and its reduction could have a noticeable effect. Therefore the treatment program by reducing the level of anxiety could cause an improvement in the level of perceived value of mathematics which may account for the changes occurring on this component following treatment.

It must be noted at this point that the above is mere speculation on the investigator's part. However, it would appear that the variation in response to the attitude components does indicate that attitude is complex in nature and may be alterable through the treatment of anxiety. Thus the relationship between attitude and anxiety merits further investigation.

Application, with modifications for university students, of Sandman's forty-eight item mathematics attitude inventory (Aiken, 1976) measuring 6 constructs of attitude: perception of the mathematics teacher, anxiety towards mathematics, value of mathematics in society, self-

concept in mathematics, enjoyment of mathematics, and motivation in mathematics, may prove very informative in this regard for these components closely reflect the issues considered important by the participants in this study.

A second issue evolving from the attitude literature and the results of this study relates to the relationship between achievement, attitude, and anxiety. Attitudes appear to be very much influenced by ability and early achievement as demonstrated by Aiken, 1974 and Keeves, 1973 (Aiken, 1976) though several variables seem to be involved as well. It was been suggested by Callahan, 1971 and Taylor, 1970 (Aiken 1976) that attitudes appear to be developed in the late Elementary and early Junior High school years. It would seem logical then that it is within this age group that the greatest influence of early success of failure in mathematics and any mathematics anxiety, perhaps as a result of the failures experienced, may occur. Similarly, this period appears to offer the greatest potential for possibly effecting a change in attitude (as it develops) as a result of the reduction in mathematics anxiety that may exist. Thus research directed towards this age group, in the area of mathematics anxiety and attitude and the effect of successful treatment of anxiety on attitude, would appear

to offer the most promise in terms of altering attitudes towards mathematics.

Performance: No significant effect in terms of performance was attributable to the treatment of mathematics anxiety. Anxiety and its reduction, in this instance appears to be an entity in itself. A lack of improved performance did not seem to adversely effect the subjects' feeling of being less anxious. Poor grades were accepted as a reflection of ability not of being "up-tight". Less anxiety allowed one to accept his or her best effort regardless of the results achieved on the performance measures.

However, the severity of the anxiety may be a crucial element involved in this issue. Clients seeking professional help often display a debilitating level of anxiety, particularly with test anxiety (Deffenbacher & Kemper, 1974; Hahnloser, 1976, Russel & Sipich, 1973) such that successful performance is not possible regardless of the level of ability or knowledge in the area for which the test is designed. Thus there appears to be a threshold of anxiety beyond which acceptable performance is impossible.

Further research in this area merits consideration, which would address itself to the investigation of mathematics anxiety and the possible existence of a thresh-

old level beyond which performance may be effected.

Volunteers and Non-Volunteers: A question arises as to possible motivation to volunteer in a study such as this. Is the motivation to volunteer a component of anxiety? It is understood that in this study group placement was defined as a result of responses given on a specific test occasion. Therefore responses may in fact, in some instances, reflect a more transitory state of anxiety and not be truly indicative of how one generally feels about mathematics. Placement then in the high anxious group from which the volunteers and non-volunteers evolved may be suspect in some instances and thus account for the inclination to not volunteer and to record a reduction in anxiety level at the time of re-testing.

The whole question of volunteer versus non-volunteer merits investigation in terms of the possible relationship between the motivation to volunteer and anxiety.

Further Research Directions

It would seem plausible to suggest, as a result of this study, that therapeutic techniques other than systematic desensitization may prove to be similarly successful in the treatment of mathematics anxiety. Objective and subjective results of this study give rise to possible directions that these therapies may take.

An important component of the treatment program, as perceived by the participants, was the cognitive awareness of one's own fears and facing of them. Two therapeutic procedures address themselves to this issue that might prove to be interesting.

In an unpublished thesis (Hiebert, 1976) described a procedure using Wolpe's Subjective Units of Disturbance to successfully reduce anxiety. The subjects were taught to cognitively self-monitor their anxiety levels and in so doing were able to significantly lower their level of anxiety.

Addressing itself to the cognitive aspects of anxiety is Rational Emotive Therapy (RET) as developed by Albert Ellis, which focusses on eradicating the irrational belief system upon which, says Ellis, unfounded anxieties lie. Maleski (1974) demonstrated RET to have been consistently more effective than desensitization in producing behavioral, affective, and attitudinal changes.

The importance of group support was attested to by both subjective and objective results. A therapeutic procedure that would address itself to this issue would be Group Counselling Therapy. The focus of the therapy would be the mutual sharing of concerns, basically supportive in nature and intent. A note of caution however,

should be made as recent studies indicate this type of treatment may not be as effective as desensitization or other therapeutic techniques.

Cognitive awareness of the success of deep muscle relaxation when applied in real life stressful situations proved to be a powerful reinforcer for the effectiveness of the program helpful in eradicating some initial scepticism in the possibility of successfully altering the anxiety felt. A therapeutic procedure that merits some consideration, as a result, would be Insight Therapy. Carter and Pappas (1975) found both awareness treatment and Systematic desensitization treatment to be equally effective in reducing anxiety. Therapy would be presented within a group setting focussing on cognitive awareness of the issues involved in their anxiety to develop insight into how their anxiety develops, insightful understanding of themselves as well as the consequent positive action based on the insights gained.

Of the aforementioned therapeutic techniques most have proven to be successful in eradicating various other anxieties. Application of any of the above to mathematics anxiety either on their own or in combination with other techniques may prove to be useful.

In summary, systematic desensitization as a therapeutic procedure to alleviate mathematics anxiety has

been successfully demonstrated substantiating the results of previous studies (Hyman, 1974). A minimal effect on attitude towards mathematics was achieved similar to Addleman's work, 1974 (Aiken, 1976), with some indication of improvement in the perceived value of mathematics. No significant effect was demonstrated in terms of performance in the mathematics methods course. Modifications in presentation through the use of audio-tape and a common hierarchy proved successful.

This study was the first application of the Mathematics Anxiety Rating Scale with a Canadian university sample and offers further evidence for construct validation of the instrument. It marks the first attempt to reduce mathematics anxiety with elementary teachers-in-training who hold positions of potential influence on the age group with whom the development of mathematics attitudes appears to occur.

This program has offered the development of a routine procedure to identify and remediate mathematics anxiety, a potential occupational hazard for teachers and has provided a successful treatment standard to which other anxiety-reducing procedures can be compared.

Stress appears to be very much a part of everyday life, particularly for university students. Issues that grew out of this study suggest that a crucial element

within the program proved to be the applicability of the skills being learned to real-life situations of stress quite beyond that of the focus of this study, mathematics anxiety. With this came the growing awareness within the individuals involved, that the anxieties felt were real, were shared by many, could be and should be brought within their own self-control. This knowledge and understanding proved to be a most powerful and exciting component of the program for all participants.

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Appendix A

Mathematics Anxiety Rating Scale

Total Items 94

Possible range of scores	Totals
Very Much (5)	470
Much (4)	376
A Fair Amount (3)	282
A Little (2)	188
Not At All (1)	94

Total population ..... 141 (first test occasion)

Results on the MARS for the total Population

Range ..... highest score 325
lowest score 108
Median 195
Mean 197

Anxiety Level Criteria for Group Placement

as defined by MARS scores within the class population

High Anxious ..... top 35% of the class
Mid/Low Anxious .....remaining 65% of the class

High Anxious Group (N=51) ... range ... highest score 325
lowest score 209
median 233
mean 243

Mid/Low Anxious Group (N=90) ... range ... highest score 208
lowest score 108
median 172
mean 169

Appendix B

Text of Address to Class

Good morning (afternoon). Thank you Prof. _____ for allowing me class time today. Presently, I'm involved in a research study, with the cooperation of the Mathematics department, here at the university. I would ask you to aid us in this research by responding to various questionnaries as accurately as possible, reflecting your feelings at the moment, when responding to the items presented. Today we will complete the first two questionnaires, the remaining two will be given next week.

After all four have been completed I will be asking some of you to participate in a follow-up study which will entail our meeting together three times a week over a period of 3 weeks. During that time we will strive to offer you a program that, research has shown, will benefit you in your studies, specifically in the area of Mathematics. For those who are not included in the study, the program will be made available to you on audio-tape which may be used at your convenience at a later date.

The first questionnaire involves your rating of the Enjoyment and Value of Mathematics. Please do not mark the questionnaire or accompanying response sheet in any way until directed to do so. Thank you. (Hand out the Aiken scales and computer answer sheet).

On the computer response sheet please place your name, the year of program you are in, a telephone number where you can be reached. All information given by you and your responses to these questionnaries will be kept confidential and will in no way effect your course gradings.

Mark each response clearly, staying within the box provided. Take care to respond to all questions, choosing only one response for each. Begin with the Enjoyment scale using response section 1-11 on your answer sheet. When completed go on to the Value scale using response sections 12-21. When complete please check all questions being sure each is responded to, totalling 21. Any questions?

Let's direct our attention to the response choices so that no confusion results. (Read these over) No more questions? Let's proceed then. Please try to respond with your first feeling as it is expressed, moving fairly quickly through the items. I will ask them to be handed in when all are done. (Hand in the Aiken Scales, and answer sheets separately).

The second questionnaire is the Mathematics Anxiety Rating Scale. The items on this scale refer to things and experiences that may cause fear or apprehension. Please respond to each item as you feel now. I would again encourage you to respond with your feeling of the moment, moving fairly quickly through the various items. Please do not mark anything on your response sheet until directed to do so. Thank you. (Hand out the MARS and computer answer sheet).

On the computer answer sheet place your name, year of program and whether you are involved in student teaching this term or not. If not please respond by either student teaching last term (fall) or no student teaching.

Mark each response clearly, staying within the box provided. Take care to respond to all questions, choosing only 1 response for each. Begin with response section 1 through 94. When complete please check to see all 94 items were responded to. Any questions?

Let's direct our attention to the response choices available so that no confusion results. (Read these over). No more questions? Let's proceed then. Please try to respond with your first feeling as it is expressed, moving fairly quickly through the items. I will ask to have these handed in when all are done.

(Afer 45 minutes approximately) Hand in the questionnaire and answer sheet as you leave. Thank you for your cooperation.

Appendix C

Text of Address to Class

Good morning, I mentioned at our first meeting last week that I would be asking certain individuals to consider participating in a research study, which will begin next week. Would the following people please remain behind for a moment after class so that I may briefly outline the purpose of the study for your consideration. Thank you Prof. _____ and all of you for your patience and cooperation. I've greatly appreciated your time and effort. Thank you.

(To the small group after each seminar group)

Basically, our research project is in the area of Mathematics anxiety. You have been chosen to be considered as a participant in this study as a result of your apparent higher level of anxiety, specifically in Mathematics tasks. Over these next 3 weeks I will be offering to those of you who are willing and able to participate, a treatment procedure which, numerous studies have shown, will effectively teach you to noticeably lessen your anxiety level in various mathematics-related situations. The specific parameters of the procedure being followed will be outlined later for those who will be involved, including others in EDCI-216, who like yourselves have demonstrated a substantially higher level of anxiety in Mathematics.

I would like to meet all of you here in 9-34 (your large lecture room) this afternoon at 4.00p.m., at which time I'll briefly outline the study procedure. I'll then be asking you for a decision regarding your participation in this study. We can then arrange a convenient time for our meetings over the next 3 weeks. I anticipate that the study will begin next Tuesday, Jan. 25 at a time convenient to those who agree to participate.

Thank you for staying. I'm looking forward to seeing all of you briefly at 4.00 this afternoon. If by chance you are interested in the project but can't be here at 4.00 please see me for a moment now before you leave and we can make other arrangements for you.

4.00p.m. Address

Thank you all for remembering to return this afternoon. No doubt it has been a tiring day and I'll endeavor to not keep you too long. As I mentioned to you earlier today, the research study is in the area of anxiety - specifically with Mathematics. We are very interested in the possible use of various proven techniques in anxiety-

reduction to help alleviate students' anxiety regarding Mathematics, specifically while taking EDCI 216.

In order to study the effects of one such procedure this particular study has been designed. Out of this group, all of whom appear to have some anxiety in Mathematics, we wish to establish 2 groups - one of which will receive the treatment procedure this term. The treatment will be made available to the 2nd group who will meet for treatment at the conclusion of the 1st group's sessions.

Needless to say I would be really pleased of all of you decide to volunteer - however, I must make it clear that facilities available are such that it is only possible to accomodate 20 people in each group at this time. However, I will be asking all of you to help us out by responding to 2 of the questionnaires once again midway through this term.

Are there any questions to this point?

If not, I will send around a sheet of paper. Please indicate beside your name whether you would like to participate or not, check times available for meeting using a "1" to indicate a preferred time if you have a preference. If there are any further questions please feel free to come and see me.

Of those who are considering becoming a participant how many could meet for our initial session next Tuesday, Jan. 25, at 4.00p.m? (Raise hands) We will be using room 157 in the clinic on the main floor of the new wing. It is a very private, comfortable room, carpets, quiet lights, with comfortable couches, lounge chairs and the floor for our use - room for all of us.

That's great. Just sign the sheet being circulated and I will contact you briefly on Tues. in your seminar groups.

I'm really looking forward to working with you. Thank you all for coming.

Appendix D

Performance and Treatment

Groups: High Anxious Treatment (A and B)
High Anxious No-Treatment (C)
Mid/Low Anxious (D)

Professors: 4 of the 5 seminar groups are involved designated I, II, III, IV, V of which only II to V are used in the performance comparisons

Matrix of All Numbers

	Professors	Groups A and B	C	D	
Available for Performance Comparisons	I	2 + 3	6	15	
	II	2 + 0	4	12	
	III	5 + 1	3	14	
	IV	0 + 2	8	13	
	V	2 + 1	5	6	
Totals across all 5 Profs.		11 + 7	26	60	=104
Totals available for Performance Comparions (Profs. II to V only)		9 + 4	20	45	= 78

Appendix E

Normative Data for the MARS (Suinn, 1972)

Table 1

Means, SD's and Reliability Coefficients for the MARS for Three Samples

Sample	Mean First Testing	Second Testing	Reliability (Test-retest internal consistency)
Colorado State University (N = 119)	187.3 (55.5)*	179.9 (59.9)	.78 (after 2 weeks)
University of Missouri Sample A (N = 35)	235.1 (51.3)	232.9 (56.5)	.85 (after 7 weeks)
University of Missouri Sample B (N= 397)	215.4 (65.3)		.97

* Figures in parentheses are standard deviations.

Table 2

MARS Score Percentile Equivalents

University of Missouri
(N = 394)

Percentile	
10	140
20	160
25	165
35	185
50	215
60	230
75	255
80	265
95	315

Appendix F

Questionnaire

I would appreciate your responses to the following as you reflect on your experiences as a participant in the Systematic Desensitization/Relaxation program this term. Expand your responses in any way that truly reflects your feelings about these issues. You may include your name if you wish although this is not essential.

Thank you for your assistance and cooperation throughout this study.

Elaine Gillingham

Describe how you feel about the experience of participating in this study.

Was it personally beneficial? If so, in what ways?

How did you feel about mathematics before the study began? After?

Has your approach to mathematical situations changed in any way as a result of your participation in this study? How?

Has your anxiety about mathematics changed in any way? Explain.

Has your approach to other possible anxiety-arousing situations changed in any way? Explain.

How do you feel about teaching mathematics now? Does this represent a change in attitude? If so, to what would you attribute this change?

Regarding the Procedures we followed:
Please comment on the techniques used - how you felt about doing each - your problems during the sessions themselves - your skill development over time.

Relaxation Technique

Visualization of the Scenes

Systematic Desensitization/Relaxation Technique

Do you have any suggestions which might improve this program for future study groups?

Is this a beneficial program - generally? In what ways?

Would this program (or other similar ones) be a helpful addition to the Education program? To Ed. C.I. 216?

Would you, if director of Ed. C.I. 216, make this program (or ones similar) available to the students? If so, how would you implement it and for whom?

Any further comments?

Name: (if you wish) _____

Appendix G

Treatment Session 1

I'd like to begin our sessions together with a brief look at some of the ideas upon which our study has been built. I'll be talking about anxiety a little and how we become anxious. From there I will introduce you to a procedure that has been developed by Joseph Wolpe in 1968, to overcome anxiety. If at any point along the way you are unsure of any of the ideas, please feel free to ask questions. It's quite important that what we're talking about makes sense to you.

In the past, anxiety has been considered by some to be an inherited characteristic - like father like son, if your parents were tense, nervous types then chances were you too would be and there really was little to be done about it. Others, like Freud, considered anxiety to be merely a symptom of some deep, underlying causes hidden in the unconscious and that probably had their beginnings in early childhood. The way to overcome these anxieties was to delve deeply into the unconscious which meant lengthy periods of time stretched out on a psychiatrist's couch reliving those hidden, early childhood experiences, the roots of the anxiety which had been hidden. (In spite of the dim lights, lounge chairs and couches around us this is not the approach we are suggesting!)

In the late 1920's another view began to evolve. Pavlov began his work with classical conditioning, observing how behaviour was learned and altered by the environment in which it occurred. Others followed along this vein - Thorndike, Watson, Skinner. Out of their experiments grew the notion that behaviour - both adaptive (helpful) and non-adaptive (harmful) was learned.

A young child cries, Mother comes and picks him up. Through repeated occurrences of this response pattern the behavior habit of crying for attention is built up. The child "learns" that in order to get attention he should cry. He has learned what for him, based on his experience in his home environment, is an adaptive behavior, one that fulfills his need for attention.

In a similar way, a young girl walking across a field sees a snake, screams and runs away. She too, has learned to respond in a given situation in a particular way that for her is adaptive. Her anxiety expressed is realistic leading to avoidance of real danger. However, if the girl continues to experience the anxiety whenever she goes across that field, and begins to avoid going home by that

route, though it is the shortest way then this expression of anxiety would be described as nonadaptive, not related to realistic dangers, causing her to respond in unnatural ways.

Thus a distinction can be made between fear of realistic danger and anxiety in situations where no real danger exists. The resultant behaviour from this anxiety is often not in your best interests and hinders your performance.

Often when we experience a realistic fear in a situation there is a tendency for different aspects of the situation to ellicit the anxiety response later on, even when the realistic danger no longer exists. Certain aspects of the original fearful event become associated with the anxiety response such that they alone become capable of generating the feelings of anxiety. Thus the connection has been made, an anxiety response has been learned, the mere sight of the field causes anxiety in the young girl.

Joseph Wolpe (1969) suggested that since these anxiety responses are learned they can be unlearned through a process called counterconditioning - the extinction of unpleasant emotional reactions (anxiety) occurs because these usual anxiety responses cannot take place when one is experiencing more pleasant emotional reactions (such as deep relaxation). Since you can't be relaxed and tense, at the same time, the anxiety can be systematically reduced by pairing the feared situations with deep relaxation. Wolpe has developed just such a procedure called Systematic Desensitization - the unlearning of anxiety responses that have been previously connected to specific situations by replacing them with new responses, deep relaxation. Numerous studies have been done since Wolpe first introduced S.D., replicating his success in many areas of anxiety such as fear of snakes, fear of heterosexual relationships, fear of tests, and fear of Mathematics to name just a few.

The anxiety responses that we are interested in are those you have experienced as a result of your previous experiences with Mathematics. It is to these that the program will address itself.

Systematic desensitization uses 2 main procedures - deep muscle relaxation and counterconditioning which I spoke of earlier. You will recall the basic principle was, that the anxiety response you feel may be inhibited by the presence of a stronger response which is antagonistic to it, involving the same bodily reactions. An anxiety-producing

situation is presented while you are in a state of deep relaxation (quite incompatible with the anxiety state). As long as this deep relaxation response is stronger than that of the anxiety, desensitization occurs as you visualize, imagine the previously anxiety-arousing situations. These situations then lose their ability to evoke anxiety, the previously learned anxiety response is thus un-learned.

The real advantage of relaxation is that your muscle systems can't be both tensed and relaxed at the same time. Once we learn the relaxation technique we can use it to counteract the anxiety and tension you have experienced in various mathematics situations. Relaxation techniques are easy to learn in a very short period of time. Through practice we can all learn to become very deeply relaxed.

Relaxation itself has been shown to reduce anxiety to a degree and I'll be asking you to practice your relaxation technique between meetings. We will use this relaxation technique to desensitize specific mathematics situations so that your anxiety related to these situations no longer occurs.

We will look at a variety of situations in which you may become progressively more anxious. We will then build up a hierarchy of least anxious to most anxious situations with regard to Mathematics. Each one will individually organize his own particular hierarchical order reflecting his/her particular anxiety progression. We will focus on our hierarchy in the next session. Now we will begin to learn the techniques of progressive deep muscle relaxation.

Relaxation is a skill which will improve with practice. At first it will take approximately 20 to 30 minutes to go through the entire procedure properly, but eventually you will be able to become quite relaxed in 10 to 15 minutes. The basic principle is that when muscles are tensed and then released, they go into a deeper state of relaxation. It is important to focus your thinking on the muscle area you are relaxing. The procedure will be to tense the muscle group for approximately 5 seconds, say "relax", then relax that muscle group immediately.

Let's begin by everyone becoming as comfortable as possible, as relaxed as possible - your head resting on the back of your chair, arms and legs comfortably extended in a postion of rest so that none of your body muscles are being used to support yourself. Loosen any constricting clothing, remove contact lenses, close your eyes.. relaxation is ready to begin.

Tense/Relaxation Tape .....

(after a brief period of quietly collecting our thoughts after the tape's conclusion ... proceed to explain the next session, describing the homework to be done)

Tomorrow we will each develop our own hierarchy of anxiety-evoking situations upon which we will direct the desensitization procedure. Then we will once again place ourselves in a state of deep muscle relaxation and begin working with our hierarchies.

Before our session tomorrow I want you to practice your deep muscle relaxation technique, remembering that through practice your skill will improve. I have an outline here for you, to help with your personal practice in deep muscle relaxation. When we meet tomorrow I will be interested in hearing about your experiences during practice times. (A brief discussion re confidentiality).

Good night. I'll see you all here tomorrow than at _____.

Treatment Session II

Initially, have a brief informal sharing of experiences in practicing deep muscle relaxation the night before.

Today we'll begin by each developing our own hierarchy of situations involving Mathematics that may ellicit anxiety responses in varying degrees. Read each situation carefully. Feel free to ask any questions that you may have.

(after an appropriate time ...)

Choose the situation that for you would be the most anxious, give it the number "18", for it will become the last item that we desensitize. Now choose the situation that arouses the least amount of anxiety and number it "1". Move through the remaining items ranking them between "1" and "18" in an order of progressively more anxious situations from least anxious at "1" to most anxious at "18".

(allow enough time to do this ...)

Read over your items in the sequence you have selected from "1" to "18". Make any changes that you feel

should be made as you go along.

(allow enough time to do this ...)

As we move into the desensitization process each one will follow his/her own sequence, desensitizing each situation in an order of least anxious to most anxious that is uniquely your own. Place your hierarchy down near you. Put your pencils away and let's prepare ourselves for deep muscle relaxation. Loosen any constricting clothing, comfortably rest your whole body in a postion that will allow your muscles to relax letting the chair or couch support you. Close your eyes and begin to relax . . . To help you relax even more . . I'll be asking you to use your imagination... to visualize a situation ... as vividly as possible . . . using as many of your senses as possible ...

Tense/Relax Tape

Just continue to relax as you are ... appreciating that warm, heavy feeling spreading through your body ... While you're relaxing I'd like you to imagine yourself in the following situation as vividly as possible...

You're standing in the middle of a forest .. by a brook... here comes a crumpled piece of paper floating downstream... watch it as it floats by you ... listen to the sounds of the woods ... smell the freshness of air... continue to watch the paper floating downstream until it is out of sight. . . Good, now stop imagining that scene and relax ... enjoy the quiet feeling of your body .. as you relax even more deeply ...

Now imagine yourself as vividly, as realistically as possible in a very pleasant place in which you have felt safe,... felt comfortable ... Take a few moments to picture this special place ... make it as sharp and clear and real as you can ... Stop, erase that scene from your mind and relax... become more deeply relaxed .. oh so relaxed ... enjoying the warmth of your body as you relax ... Now imagine your special place once again... make it as real, as clear, as sharp as you can ... Stop, erase that scene from your mind and relax .. enjoy the calm and deep feelings of relaxation ... your whole body is so relaxed ... all your body is so relaxed ...

After awakening, allow a few moments to gradually unwind and become more alert. Have a brief discussion, informally, of the efficacy of the relaxation, the clarity of the situations imagined, the visualization procedure sometimes called "Imagination Control" imagining a scene for a

few seconds, switching it off to concentrate on relaxation.

Next session we will use our imagination control and deep relaxation to desensitize the first three situations in your hierarchy. Remember that only through practice will your relaxation techniques improve. Let's all practice our relaxation procedures tonight before our next session tomorrow.

Treatment Session III

(Initially, a brief informal sharing of experiences in practicing muscle relaxation the night before.)

Today, relaxation will concentrate on relaxing our muscles. You will not be asked to tense your muscles. Once you have reached a state of deep relaxation I will be asking you to prepare to desensitize the first scene in your hierarchy. We will then proceed to work though the first 3 scenes in your hierarchy.

Look at your first scene for a moment. Think about that scene (30 seconds). Out next target for desensitization will be your second scene. Look at it for a moment. Think about that scene (30 seconds). Our last target for today will be your third scene. Look at it for a moment. Think about that scene (30 seconds).

Place your three scenes in order - 1st, 2nd then 3rd near you, where you can refer to each briefly if need be when we prepare to desensitize each in turn.

In desensitization you are going to learn to respond with this feeling of deep relaxation and calm to situations that may in the past have caused you to feel tense or anxious...

As you focus on your targets for today strive to visualize as vividly as possible each scene - the location, sensations, sights, sounds, smells, - so that it can be as vivid and real as if your are actually there.

(Direct the subjects to become comfortable, loosen any restricting clothing, relaxing comfortably in their chair or couch, close their eyes and relax.)

Auto/Relax Tape

S.D. Tape (the following was presented on audio-tape)

Focus your attention now on yourself .. setting your mind to becoming very deeply relaxed ... just let your body go loose and easy ... and relax ... your whole body becoming very completely relaxed... continue taking yourself down...becoming more and more comfortable, entirely filled with peace and calm... feeling a placid tranquility in your body.. becoming stronger and more complete.. as you relax even more... more deeply... so very relaxed... so totally at peace..enjoying the pleasant feelings of relaxation... your body very calm.. your mind at rest, only concentrating on becoming more deeply relaxed..just floating... down... more deeply at peace (sigh) so comfortable within yourself.. and very relaxed...

In a few moments I'm going to ask you to imagine your first scene for today. When you do so I want you to imagine it as fully and completely as you can. When I say to stop, thinking about that scene, I want you to immediately erase that scene from your mind and direct all of your attention to relaxing your body....

* Right now you are very relaxed, very much at peace... totally calm...

Now imagine the first scene you are working on
(5secs)

Stop, Erase that scene from your mind.. and relax...(45secs) Just relax.. letting all of your muscles go loose..concentrate on relaxing..more and more completely...searching out any last tensions and relaxing them away...very deeply relaxed... enjoying the pleasant feelings of relaxation.

Again, imagine the scene you're working on...
(10 secs)

Stop. Erase that scene from your mind.. and relax...(45secs)

... just re..lax... all of your muscles loose...concentrating on making them even more loose..more at peace...every fibre... so completely relaxed...feeling very calm within yourself...as you concentrate on making yourself even more relaxed..your body saturated with peace and calm..and so relaxed...

Imagine the scene again.... (15 seconds)

Stop. Erase that scene from your mind.. and relax (45secs)

...just concentrate on relaxing so..completely..your body so loose...becoming even more relaxed...your breathing easy and regular...so calm,...your heart at peace in your chest...

your body so very relaxed...enjoying the pleasant feelings of relaxation...very relaxed indeed.....

We will work on this same scene three more times, making the scene even more vivid...more real...clear and sharp...broadening the vividness in our imagination.

Right now you are very relaxed, very calm, totally at peace....

Imagine your scene once again.....(20secs)

Stop, erase that scene from your mind...and relax (45secs) ...just relax...letting all of your muscles go loose..concentrating on letting your muscles go more and more relaxed.. searching out last tensions and relaxing them away...very deeply relaxed...enjoying the pleasant feelings of relaxation...

Again imagine the scene you're working on (25secs) (make it sharp...colourful...)

Stop. Erase that scene from your mind...and relax...(45secs) ...just re-lax....all of your muscles loose...concentrating on making them even more loose...more at peace...every fibre...so completely relaxed...feeling very calm within yourself...as you concentrate on relaxing even more completely...your body filled with peace and calm.. and <u>so</u> relaxed...

Imagine the scene again...(30secs) (make it clear sharp - so real)

Stop. Erase that scene from your mind...and relax (45 secs). ...just concentrate on relaxing...so completely...all of your body loose...becoming even more relaxed...your breathing easy and regular...so calm...your heart at peace within your chest...your body so very relaxed...enjoying the pleasant feelings...of relaxation...very relaxed indeed....

Now we are going to move on to our 2nd target for today...be prepared to become desensitized to that item...

revert to * (for scene #2 for today)
revert to * (for scene#3 for today)

Go to your special place. Imagine yourself there now. The air is clean and good...You can feel the breeze on your skin..and relaxing more deeply than you have throughout the entire exercise...so very deeply relaxed. It feels so good to be there. Your body filled with peace and calm,

deeply relaxed indeed...enjoying the pleasant feelings... just continue relaxing...so very relaxed...you may gently rouse yourself by slowly counting backward from four to one. When you reach one you will be wide awake, fully alert...and feeling fine. Four.....three.....two.....one...

(Informally discuss the homework assignment over the weekend - ready for next Tues' session...stressing importance of practicing relaxation twice a day, each day...Provide a handout of the relaxation procedure to assist them.)

Treatment Session IV

(Initially a brief informal discussion of experiences in relaxation practice over the weekend...)

Today, and in all remaining sessions we will begin our desensitization by focussing initially on the last scene desensitized from our previous session.

I will be asking you to visualize as clearly and as vividly as you can first the review scene - then we will focus on the first target scene for today, then the 2nd target scene, then the 3rd target scene. For the new target scenes we will use six presentations to desensitize each as before.

Thus our targets for today will be scene3 (which we will review only once) followed by scenes 4, 5 and 6. Look at scene 3 for a moment. Think about that scene (30 seconds). Look at your 4th scene. Think about that scene for a moment (30 seconds). Look at your 5th scene. Think about that scene for a moment (30 seconds). Finally look at your 6th scene. Think about that scene for a moment (30 seconds).

Place your scenes in order - review scene #3, new target scenes 4,5 and 6 - near at hand, where you can refer to each briefly if need be when we prepare to desensitize each in turn.

Auto/Relax Tape (pus review section..)

Systematic Desensitization Tape - for the 3 new scenes and visualization of the "special place".

(Informally discuss the homework assignment for tonight).

Treatment Sessions V, VI, VII, VIII

(Initially a brief informal discussion of experience in relaxation...for each session...and applications in everyday moments of stress.

Discuss the procedure - review scene...
- new targets for today...

Look at each in turn. Think about that scene (30 seconds). Choose a memory peg to aid recall during desensitization. Prepare to begin relaxation and desensitization. Sort and place cards conveniently nearby.

Auto/Relax Tape (+Review section)

Systematic Desensitization Tape - proceed through the 3 scenes for each day ending with visualization of the "special place".

Reminder of homework for the next session.

Final Session: Post-treatment Test

- contact all control subjects
- meet in original testing room
- administer Aiken and MARS as before using the same structure and format
- give out the Self-Report Questionnaires to the group having just completed treatment to be returned to me by campus mail.

Follow-up Session (test occasion IV)

Re-administer Aiken and MARS instruments following the same procedure as before.

Note: A letter was given to each of the volunteers for the second treatment group to help organize times and as a reinforcer to avoid undue attrition.

The 2nd study group in the Mathematics Anxiety Program is about to begin. I wish to extend to you an invitation to consider joining this group. It will involve a relatively small investment of your time while offering to you an experience that has been shown to be very successful in reducing anxiety.

I realize that the term is nearing the mid-point and course assignments and tests are upon you. However, it is to this very pressure and resultant anxiety that the program is directed, to help you cope with these feelings more effectively.

It would be preferable to follow the pattern established in the first group as closely as possible. We have been meeting for 1 hour, 3 times a week (Tues., Wed., Thus.) for a total of 9 sessions. However, the times and days for our 2nd group will be arranged at times convenient for us all.

In order to organize appropriate meeting times for all concerned it is necessary to get together this week on Thursday, Feb. 10 at 3.30 here in the Mathematics seminar room (934). The first group will join us then, providing the opportunity to discuss with them some of their experiences during their program. Reading Week will fall during the period in which the study will be running. However, we <u>will</u> by-pass it, concluding our sessions in the week following. Tentatively, the last session will probably be on Thursday, March 10.

I'm looking forward to working with you in the weeks ahead.

Sincerely yours,

Elaine Gillingham

Please complete the questionnaire enclosed, returning it to Dr. Olson's office (937) today. Thank you for your assistance and cooperation.

QUESTIONNAIRE

Name: _____

Home phone: _____

I am interested in joining the 2nd Study group. Yes
No

If "YES", please continue . . .

I will be at the Thurs., Feb. 10 meeting at 3:30 in the seminar room (934) (It is a very important meeting) Yes
No

Times I am available for the study sessions (please check all possible times)

	Mon	Tues.	Wed.	Thurs.	Fri
9:00 - 10:00					
10:00 - 11:00					
11:00 - 12:00					
12:00 - 1:00					
1:00 - 2:00					
2:00 - 3:00					
3:00 - 4:00					
4:00 - 5:00					
5:00 - 6:00					

NOTE: It is possible to use hours beginning on the half hour (i.e. 9:30 - 10:30)

My preference for the 3 days are: Mon. Tues. Wed.
(check 3) Thurs. Fri.

My preference for times are: 1st 2nd 3rd

day 1
day 2
day 3

Any comments?

Appendix H

Arnold A. Lazarus Relaxation Sequence

The purpose of this tape is to teach you the technique called deep muscle relaxation. If you listen to the tape carefully and do what it suggests, in from two to five sessions you can learn to relax, at will. You should be able to put yourself into a very pleasant and comfortable state known as deep muscle relaxation.

Begin by loosening any of your clothing that are tight or constricting, and then find yourself a comfortable position. You can lie on a couch or a bed, or sit in an easy chair or you can lie on the floor. Lie down, or sit down, get yourself very relaxed and comfortable, close your eyes, and we will begin. This technique works by teaching you to identify tension in the muscles of your body, and then to identify the opposite of that tension which is deep muscle relaxation.

I want you to clench your left fist, I want you to clench it very tightly and to study those tensions. Hold it! and now relax. Relax your left hand and let it rest comfortably. Once again now, clench your left fist, clench it very tightly and study those tensions. And now relax. Relax your hand, and once again make the very pleasant contrast between tension and relaxation. Now do it with your right hand. Clench your right hand. Study the tensions in the hand and forearm and now relax. Let your right hand go loose and relaxed. Once again clench your right hand. Study the tensions. Hold it! and now relax your right hand. Let your hand open and get very relaxed. Note the relaxation that is very gradually coming into your left and right hands. Now bend your left hand upwards at the wrist so as to point your fingers toward the ceiling. And study the tensions now especially in the back of the hand and in the forearm. Study the tension and now relax. Relax your wrist and notice the difference between tension and relaxation.

There is no need to strain the muscles when I tell you to tense them. All you have to do is tense them a little bit below the level where they would be strained. So do that once again with the left wrist. Point the fingers upward so that you can feel the tension in the back of the hand, and in the forearm. And now relax that once again. Now let the left hand rest comforably and continue to relax. Now let's do the same thing with the right hand. Point the right hand upward at the wrist. Study the tensions and now

relax that, let it drop down and notice the difference between tension and the pleasant feeling of relaxation. Once again. Bend your right hand up at the wrist pointing toward the ceiling. Study the tension, Hold it, and now relax. Relax your right hand. Let it go loose and enjoy these feelings of relaxation that become more evident in both the left and right hands and forearms.

Now with both arms, I want you to flex the bicepts muscles by bringing the hands up towards the shoulders. Almost trying to touch each shoulder with the respective hand. Study the tension and now relax. Note the difference here primarily in the bicepts, the difference between tension and relaxation. Let's do that once again. Bring both arms up, flexing the bicept muscles, feeling the tension, making them hard. And now relax once again. Relax those muscles, noting the difference between tension and relaxation.

Now I want you to shrug both shoulders. Bring both shoulders up as if you wanted to touch your ears with your shoulders. Way up! and feel the tension in the shoulders and back of the neck. Feel it too in the upper back. Study the tension and now drop your shoulders. Relax those muscles, let them get limp and loose and relaxed. Let's do that once again. Shrug your shoulders, bringing them way up, almost to touch your ears. Study the tension, and now relax. Let the shoulders drop down and continue to soak up these feelings of relaxation spreading now into the shoulder area.

Now I want you to wrinkle up your forehead. Wrinkle it up frowning. Make it as wrinkled as you possibly can. Study the tension around the eyes. Above the eyes in the forehead region. And now smooth out the forehead. Relax those muscles. Let them get very loose and smooth and relaxed. Once again, wrinkle up your forehead. Study the tensions in the forehead above the eyes. Study the tensions and now relax. Relax the forehead. Smooth it out and note once again the difference between tension and the very pleasant feeling of relaxation.

Now I want you to close your eyes tightly. Close them tightly so that you feel the tension around your eyes. Study that tension and now relax. Let your eyes remain lightly closed as they were before. Very relaxed, comfortably relaxed. Once again, close your eyes very tightly, study the tension, and relax now, relax those muscles, let them get loose and relax.

Now I want you to press your tongue up into the roof

of your mouth. Tensing the muscles that control the movement of the tongue. Study that tension and relax. Let the tongue drop down to the floor of the mouth and rest comfortably. Relax. Let's do that once again. Push your tongue up into the roof of your mouth, feel the tension in the mouth and now relax. Relax those muscles as you have been relaxing the others. And let yourself get more and more relaxed now, more and more relaxed.

Now I want you to press your lips together. Press your lips together so that you can feel tension around the mouth. Push them together, study that tension, and now relax. Just relax your lips, your mouth, noting once again the difference between the tension and relaxation. Once again. Press your lips together. Study the tension around the mouth. Hold it! Study it, and now relax. Relax those muscles, let your lips be slightly parted as they are when your mouth is completely relaxed. Relax and let yourself be very comfortable.

Now I want you to push your head back. Push it back so that you can feel tension in the back of the neck. Push it back. Study that tension and now relax. Let your head return to where it was before, to the resting position and feel the relaxation. Feel the relaxation now going into the area of your mouth. Once again, push your head back against the chair, or the bed, or the couch. Study the tension in the back of your neck. Hold it. And now relax. Relax those muscles and let them get more and more comfortable and loose and relaxed.

Now I want you to bend your head forward and bury your chin into your chest, tensing the muscles more in the front of the neck now. Feel that tension and now relax. Let the head go back to where is was. Note once again the difference between relaxation and tension. Do that once again. Push your head forward until the chin is buried into the chest. Study that tension and now relax. Relax those muscles. Note how the relaxation is spreading now down from the forehead, through the facial muscles, and now into your neck. Note also how it is developing more and more into the shoulders, the upper back, the arms, the hands. These parts of your body feeling more loose, more relaxed. Getting more and more comfortably relaxed.

Now I want you to arch your back. Bring your back off the chair or couch, sticking out your chest and stomach. Feel the tension now in your arched back, and then relax. Let yourself relax again, noting the difference in the tension of the back muscles and the present relaxation. Do

that once again. Arch your back up, way up, let in the tension, and now relax. Just continue relaxing like that, more and more relaxed.

Now to tense the muscles in the chest and stomach I want you to take a very deep breath and hold it. Hold it and study the tension throughout the chest area. And now exhale and continue breathing as you were. Just continue relaxing like that. Once again take a deep breath and hold it. Study the tension.

And now exhale, and continue breathing as you were, letting your breathing get more regular and more relaxed. More and more relaxed. Now take a very deep breath. Hold it. Now exhale. And once again a very deep breath. And hold it. And now exhale again. And continue breathing very naturally, just continue as you were. Your breathing getting more regular, more and more relaxed.

Now I want you to suck in your stomach. Almost as if you wanted to make it touch your spine. That's right! Suck it way in there. And now relax. Notice the difference once again. Notice the difference between the tension and the relaxation. Do that once again now. Suck in the stomach and now let the breathing get more and more relaxed.

Now I want you to tense the stomach muscles. Make your stomach very hard, as if someone is about to punch you in the stomach. Hold it! Study that tension and now relax. Relax the stomach muscles, let them get loose and relax. Let's do that once again. Tense your stomach muscles, let your stomach get very hard. Hold it! and now relax. Relax those muscles. Let them get more loose, more relaxed. Notice how the relaxation is spreading downward now. Through your chest and now into the area of your stomach.

Now I'd like you to tense the buttocks by pushing your seat down hard. Push your seat down hard and study the tension, and now relax. Relax those muscles, let them get more loose, more relaxed. Once again now, push your seat down hard. Study the tension now in you buttocks muscles. Hold it! And now relax. Relax those muscles, let them get more loose and more relaxed.

Now I want you to tense the thigh muscles in both legs. Stretch out both legs lifting the feet of the ground, making the legs as straight as you can, feeling the tension in the muscles of your thighs. Hold it! And now relax. Let your feet drop. Let them get more relaxed. Study the very pleasing contrast between tension and relaxation. Do that once

again, tense your thigh muscles stretching out both legs as far as you can, study the tension and now relax. Just relax your thighs. Let them get loose and relax, more and more relax.

Now I want you to point your toes upward toward your face so that you are stretching the muscles in the calves. Do that with both feet. Study the tension and now relax. Relax the muscles of the calves. Let them get more and more loose. Do that once again. Tense your calf muscles by bending your feet upwards pointing the toes towards your face. Study the tension. Hold it! And now let go. Relax. Note the relaxation coming into the calf muscles now.

Now I want you to curl the toes of both feet downward as if your were burying them into the sand. So that you can feel the tension, particularly in the arches. Study that tension and the relaxation. Note the difference once again between tensing them and relaxing them. Do it again. Curl your toes downward. Study the tension in your feet, in the arch, and now relax. Notice now how throughout your whole body, your muscles have gotten more relaxed, and how you are able to capture the very pleasant feeling, the comfortable sensations which accompany deep muscle relaxation. Notice how loose and heavy your body has become as you get more and more relaxed. Even when it seems impossible to relax any further, there is still an extra bit of relaxation available, an extra bit of feeling of well being, of calm. Just let yourself get more and more relaxed; more and more relaxed.

What I am going to do now is just run through the various muscle groups that we have relaxed. And as I name each one, you make sure that that muscle group is relaxed, try to make it even more relaxed than it is now. Both hands relax, forearms and upper arms getting more loose, more relaxed; your shoulders resting easy and loose; your forehead now smooth and easy; your mouth, your neck, feel the relaxation spreading down now into your chest and stomach. Feel these parts getting more relaxed, more and more relaxed. Your buttocks and thighs feel it spreading downward into these parts and now into your calves and into your feet. Notice the very pleasant relaxation, let it get more and more relaxed now. Very comfortably relax. Just continue relaxing like that and soak up the very pleasant positive feelings that accompany this deep muscular relaxation. Just continue relaxing like that for a while.

Appendix I

HIERARCHY

___ Dividing a five digit number by a two digit number in private with pencil and paper.

___ Solving a problem such as: If x=11, and y=3, then the results of x/y is equal to _____?

___ Studying for math test.

___ Having someone explain bank interest rates as you decide on a savings account.

___ Taking an examination (final) in a math course.

___ Hearing two of your friends exchanging opinions on the best way to calculate the cost of a product.

___ Hearing a friend try to teach you a math procedure and finding that you cannot understand what he is telling you.

___ Working a concrete, everyday application of mathematics that has meaning to me, e.g., figuring out how much I can spend on recreational purposes after paying other bills.

___ Being given a set of subtraction problems to solve.

___ Being given a homework assignment of many difficult problems which is due the next class meeting.

___ Thinking about an upcoming math test one hour before.

___ Opening a math or stat book and seeing a page full of problems.

___ Getting ready to study for a math test.

___ Figuring out your monthly budget.

___ Being given a "pop" quiz in a math class.

___ Observing the classroom teacher teach her class, to which you have been assigned for student teaching.

___ Preparing your lesson, ready to teach the next morning.

___ Standing in front of the class ready to begin to teach your math lesson.

Appendix J

George Fitzsimmons on Relaxation Training
Transcribed and edited by J. & K Ahronson

Part I The Training Tape (of 30 minutes duration)
Part II Detailed application of the techniques of relaxation when working with a client

Part I The Training Tape (of 30 minutes duration)

Key: , will signify either a change in inflection or a very brief pause

..... each . represents a one second pause

This is a relaxation training tape.. for new clients, who have not previously experienced relaxation.

"OK would you just make yourself comfortable please, sit in a comfortable position....both your feet on the floor...That's good! Just making yourself comfortable... geting your mood set, to let your whole body relax.....

It's important that we understand the difference, between relaxation and tension. We all know what it's like to be tense.. but sometimes we forget, what it's like to relax..... So to compare the two, I'd like you to tighten your hands into fists.. Tighten them up just as tight as you can.. And notice the sensations in your hands, wrists, and forearms.. Feel the tightness in your knuckles.. Feel the shaking in your wrists..and the tightness in your forearms.. That's tension!..

Now gradually release your hands..letting them relax more and more, letting all the tension flow out of your hands, and your wrists and your forearms.. Let your hands become completely relaxed..... That sensation, that you feel in your wrists, in your forearms in your hands, is what we will define, as relaxation.....

Let's tighten up once more.. Make your fists, tighten them up really tight, just as tight as you can.. Notice the tension in your forearms, feel the tightness of your muscles, your fingernails biting into your hands, the tension in your fingers..and now let them relax.. Let your hands relax.. and your wrists relax.. and your forearms relax.. Let all the muscles in your lower arms and hands, completely relax... Just let go..and let the pleasant feelings of relaxation..spread through your forearms and

hands..... I want you to go ahead letting those muscles relax more and more, as we concentrate on other parts of your body...

Think about your upper arms, and let those muscles relax, from your elbows up to your shoulders... just let them relax... The big biceps and the triceps... and all the other muscles of your upper arms, just let them go, and let them relax...becoming more relaxed and more relaxed.....

Now think about your upper back, from your shoulders across to your shoulder blades, from one shoulder across to the other and back again. And let all those muscles in your upper back relax... Just turn each tension off. Let each muscle relax completely.. As you let go.. letting all the muscles in your upper back...relax....

Think about your upper chest.. From one shoulder across under your throat and back up to the other shoulder...and let all those muscles relax... Just let them go..becoming more relaxed, and more relaxed as all the muscles in your upper chest.. relax.....

Think about your upper stomach.. and let all those muscles relax. From your tummy round your hips to your backbone and back again, letting all the muscles in your upper abdomen become more relaxed, and more relaxed.... Just let them go..turning off each muscles, and letting it relax even more.. So that all the muscles in your upper abdomen, are completely relaxed.....

Think about your lower stoma ch, and let all those muscles go.... From your lower stomach round to your hips, and up to your kidneys, and back again..let all of those muscles, relax.... Let them feel loose, and easy..as you let all the muscles in your lower abdomen completely..relax ... Just let them go, becoming more relaxed and more relaxed, and more relaxed.....

Think about your thighs, from your hips and to your knees.. And let all the muscles in your thighs relax.. Along the tops of your thighs..along the bottoms of your thighs..letting all the muscles relax..... Just let all the muscles in your thighs become completely loose, and easy, as you let them relax.....

Think about your lower legs, and let those muscles relax.. From your knees down to your ankles, all the muscles in your lower legs.. let them relax.... Let your calves

relax.. Let the muscles along the sides of your shinbones relax.. So that all the muscles, in your lower legs are ever more relaxed.. Just let them go, and let them relax.. ....

Think about your ankles and feet, and let them relax... Let the relaxation spread, down the back of your heel, and out along the sole of your foot, to your arch, to the balls of your feet, right out to your soles of your toes... Let all the bottoms of your feet, relax..... Let the relaxation spread down the tops of your feet, from the forward part of your ankle, out across the top of your foot, to your toes again...so that your ankles and feet, are completely relaxed..... Just let them go, becoming more relaxed, and more relaxed..enjoying the pleasant feelings, of relaxation .....

Concentrate on relaxing, searching out any tensions, and letting them go.. becoming ever more relaxed..

Think about your lower legs, and relax them even more ..... Think about your upper legs, from your knees to your things, and let them relax even more..... Think about your lower stomach, round back to your kidneys, and your hips, and let all of that area, relax even more..... Let the relaxation move up your spine, from your tailbone, up each vertabra, becoming more and more relaxed..right up to your neck, to the base of your skull... Letting your whole back relax completely.....

Now think about your upper trunk, your stomach, your chest..and let it relax even more...so very relaxed, enjoying the pleasant feelings, of relaxation...

Think about your neck.. Let all the muscles in your neck relax....from your chin, down to your throat, to your chest...from your ears to your shoulders...from the base of your head down to your back...

Let all the muscles in your throat, relax...becoming more relaxed..and more relaxed... Think about your face.. and let it relax...

Concentrate on your lower jaw, from one ear, down to your chin, and up to your other ear. Let all the muscles, of your lower jaw, relax... Just let them go, and let them, relax....

Think about your lips..and let them relax... So that all the muscles round your lips, are loose, and easy..as

you let them relax..... Go now to your cheeks..from one cheek, up across your nose, and down the other side, to the other cheek, and let that area of your face relax, so that your face is becoming very relaxed, feeling very loose, and very easy.....

Think about your forehead, and let all the muscles in your forehead relax....from your eyebrows, right up to your hairline.. Let all those muscles relax..so that your forehead becomes more relaxed, and more relaxed.. Just let it go, and relax....

Think about your eyes, and let all the muscles round your eyes relax.. Let your eyelids relax.. Let your eyeballs relax..so that all the area around your eyes, becomes more relaxed, and more relaxed.....

Let that relaxation spread up over your forehead, through your scalp, and back down to the back of your neck..with your whole head, becoming completely relaxed.

Search out any tensions in your muscles, and let them go.. Just let all the muscles in your head completely relax .....

While you're becoming even more relaxed, feeling so very relaxed, enjoying the pleasant feelings, of relaxation, I'd like you to imagine yourself standing beside a long black wall.... Down at the far end of this long black wall you can see a number Ten..and beside you is a number One..... In a moment I am going to ask you to imagine yourself moving to number Ten, passing each number along the way, becoming more and more relaxed. Until by the time you reach number Ten you will be more relaxed than you are now, feeling very, very relaxed. Alright, I'd like you to start moving toward number Ten, and as you pass each number, you will feel more relaxed..and more relaxed..and more relaxed...so very relaxed ..getting closer to Ten..more relaxed...and more relaxed. Just let yourself go, and relax.. So very relaxed..enjoying the pleasant feelings, of relaxation....

I'd like you to erase that scene from your mind now, and relax..enjoying the good feelings..of being very, very, relaxed.....

Now I'd like you to imagine another place, at another time.. It's summer.. I'd like you to think back..to some special place that you once were, maybe as a child, or some other time, a place where you could go, be alone with nature and relax... Find that place in your memories, and go there

now ... It's a nice day..soft breeze.. It's good to be alive.... You'll enjoy being there.. It's your special place..... Find a spot to stretch out, relax, in your special place..... Imagine yourself there. now... enjoying the good feelings, of being, in your special place, on this perfect day..... Just let yourself go..and relax even more... Feeling safe, and secure, and so very good..... just relax....so very relaxed.....more relaxed than you've ever been...so very relaxed...enjoying the pleasant feelings ..of relaxation.....

Erase that scene from your mind now...and relax...feeling very relaxed...very, very, comfortable....

You can be as relaxed, as you are right now...any time you like, by making yourself, very comfortable, in a comfortable place..letting your whole body relax..and by taking four deep breaths..and when you reach the fourth breath..you will be as relaxed, as you are right now.... I'd like you to do that with me in a minute..imagining yourself, letting every last tension out of your body, as you exhale each breath... We're going to take four deep breaths ..and when you reach the fourth breath, you will be as relaxed, as you are right now.. OK, here we go:

One...and relax..so very relaxed..
and Two...and relax..so relaxed..
and Three...and relax..enjoying the pleasant feelings of relaxation..
and Four...relax...feeling very relaxed..so completely relaxed..feeling very safe, very good, and very relaxed...

You can be as relaxed, as you are right now, by taking four deep breaths, and relaxing, just as you have done....

Now we're going to go back to complete awareness.. I'm going to count backwards, from Four to One..and when I reach One, you will be wide awake, completely alert.. feeling very good.. OK, here we go:

Four.. Thre, things are getting lighter..
Two, things are getting lighter still..and
One, and you're wide awake, and everything is fine."

Part II: Detailed application of the techniques of relaxation when working with a client

If a hierarchy has been established to which the client is liable to abreact, i.e., have a full blown panic attack with rapid heart-beat, respiration increase and profuse sweating, he may become so tense that he loses his former state of relaxation. Therefore, it is facilitative, prior to entering the hierarchy imagery to say to such clients, "Whenever I tell you to relax, you will be as relaxed as you are right now!" This instruction will rapidly reduce the level of arousal or tension within the client to a minimal level where he can then bring himself down to total relaxation again.

If your objective is more a consistent learning model, where the client is learning to control the tensions, within his body entirely on his own, then you would not make this suggestion, but would rather have him live with his tension, concentrate on it, relax it away, turning off any tensions that he is aware of in his body after a tension arousing imagery experience. It depends upon whether the client handles all of the tensions himself or only their imminence. My choice of alternative techniques is dependent upon the degree of arousal or panic the client is liable to experience from some of the higher elements in the hierarchy. Before entering the hierarchy and after the deepening suggestions have been carried out, it is necessary to remind the client of the method of signalling to the counsellor the degree of tension that he is experiencing toward the suggested image. I usually approach it in this manner. I say to the client, "While you're very relaxed and enjoying the pleasant feelings of relaxation.... I'd like you to remember...that we spoke of you showing me..whenever you feel any tension in your body... We agreed that you would raise a finger, to show me whenever you feel any tension. What finger will you raise?.."

I wait until the client raises a finger, then I say, "That very good! Now just relax! Relax your hands, relax your whole body. Just let go, and relax." Then I proceed to the hierarchy.

Following the conclusion of the therapy hour and just prior to bringing the client back to full awareness, I like to suggest that he will remember everything that has happened and usually I say something like this, "You're feeling very relaxed, and very comfortable... In a few moments, I'm going to count backwards from Four to One, and when I reach

One, you will be wide awake, alert, feeling good, and will remember everything that has happened, since you started relaxing...Here we go,". Then I count backwards.

After approximately three counselling sessions teaching the client, and modelling the client in relaxation techniques; I often introduce a post hypnotic suggestion to facilitate relaxation in future therapy sessions. I usually introduce this by outlining the clinet's progress, how pleased I am with it and his hard work at home (practicing these techniques each night). I then say that there is a way that we can speed up the amount of time together dealing with the hierarchy rather than dealing with becoming relaxed and that this can be achieved by giving the client a signal such as a touch on the forehead or wrist or some other socially safe area. Then after inducing relaxation in the prescribed manner and before entering on the hierarchy we practice coming back to awareness and going back under again with this touch cue. I usually proceed in this manner, "You're feeling very relaxed, very very relaxed..... I'm going to touch you now, on the forehead...and I want you to remember, that whenever I touch you on the forehead, you will be as relaxed, as you are right now. Feeling very relaxed..very safe, and very comfortable, whenever I touch you on the forehead."

At that point I touch the client twice on the forehead, then we practice it. And I proceed, "Now I'm going to count backwards from Four to One and when we reach One you will be fully awake. Then I will touch you on the forehead, as I just have, and you will again, become completely relaxed, as relaxed as you are right now. OK: Here we go! Four.. Three.." And I proceed to One.

Then before the person is completely alert, in other words, within the first 25 seconds of saying number One I touch him on the forehead further suggesting, "You're so relaxed, so very relaxed;" several times.

It may be necessary to use another deepening exercise but normally you can proceed to practice this a second and third time the same way. If you are going to continue to use this technique in the future, it's helpful for you to say the last time that you give the suggestions that, "Whenever we are together and it's time to relax, you can make yourself comfortable, and when I touch you on the forehead, you will be as relaxed as you are right now."